



LRFD

Section 3.43

Revised: Oct. 2006

[**CLICK HERE TO Index**](#)

3.43.1 General

- 1.1 Materials and Selection of Steel
- 1.2 Girder Limits and Preferences
- 1.3 Optimizing Girder Spacing on Non-Standard Roadways

3.43.2 Design

- 2.1 Limit States and Load Factors
- 2.2 Analysis Methods
- 2.3 Intermediate Diaphragms and Cross Frames
- 2.4 End Diaphragms
- 2.5 Part Elevation of Girders
- 2.6 Other Requirements

3.43.3 Splice Design

- 3.1 Field Bolted Splice Design
- 3.2 Plate Girder - Flange Splice Tables
- 3.3 Plate Girder - Web Splice Tables
- 3.4 Wide Flange Splice Tables
- 3.5 Shop Welded Splices

3.43.4 Composite Design

- 4.1 General
- 4.2 Shear Connector Limits
- 4.3 Fatigue Design
- 4.4 Strength Design
- 4.5 Shear Connector Details

3.43.5 Details

- 5.1 Bearing Stiffeners
- 5.2 Int. Diaphragms and Cross Frames
- 5.3 End Diaphragms for Wide Flange Beams
- 5.4 End Diaphragms for Plate Girders
- 5.5 Transverse Stiffeners
- 5.6 Longitudinal Stiffeners
- 5.7 Lateral Bracing

3.43.6 Miscellaneous Details

- 6.1 Girder Haunch
- 6.2 Girder Camber and Dead Load Deflection
- 6.3 Girder Elevation Variation Sketch
- 6.4 Spacing of Intermediate Diaphragm from Splice

3.43.1 General

1.1 Materials and Selection of Steel

General

LRFD Table 3.5.1.1

$$\text{Unit weight of reinforced concrete, } \gamma_c = 150 \text{ lb/ft}^3$$
$$\text{for modulus of elasticity, } \gamma_c = 145 \text{ lb/ft}^3$$

LRFD Table 3.5.1.1

$$\text{Unit weight of future wearing surface, } \gamma_{fws} = 140 \text{ lb/ft}^3$$

LRFD 9.7.2.4

$$\text{Compressive strength of concrete, } f'_c = 4 \text{ ksi}$$

LRFD 9.7.2.5

$$\text{Minimum yield strength of reinforcing steel, } f_y = 60 \text{ ksi}$$

$$\text{Unit Weight of Structural Steel, } \gamma_s = 490 \text{ lbs/ft}^3$$

When calculating the weight of splice, the following simplified weight shall be used.

Weight per (A325 bolt diameter 7/8" with A563 nut) = 0.95 lb/bolt

Steel Yield Strength (F_y) and Tensile Strength (F_u)

$$\text{ASTM A709 Grade 36 } F_y = 36 \text{ ksi } F_u = 58 \text{ ksi}$$

$$\text{ASTM A709 Grade 50 } F_y = 50 \text{ ksi } F_u = 65 \text{ ksi}$$

$$\text{ASTM A709 Grade 50W } F_y = 50 \text{ ksi } F_u = 70 \text{ ksi}$$

$$\text{ASTM A709 Grade HPS 70W* } F_y = 70 \text{ ksi } F_u = 85 \text{ ksi}$$

(* See Project Manager for use of F_y greater than 50 ksi.)

Fasteners

LRFD 6.4.3.1

$$\text{Splices - ASTM A325 Bolt (7/8" diameter) } F_{ub}=120 \text{ ksi}$$

$$\text{Diaphragms - ASTM A325 Bolt (3/4" diameter) } F_{ub}=120 \text{ ksi}$$

Selection of Steel

Welded Plate Girders:

Grade 50, Grade 50W, or HPS70W plate. Grade 36 may be used for webs in hybrid sections. Where appropriate for economy, hybrid sections are used for plate girder design, otherwise use homogeneous sections.

Wide Flange Beams:

Grade 50 or Grade 50W.

Diaphragms, cross frames, stiffeners, or other connection elements:

Grade 36, unless Grade 50 or Grade 50W is required by design

Splices:

Information for ASTM Grade 50 or Grade 50W is shown in this section. For Grade 36, designer shall design splice using LRFD procedure discussed in this section.

Shear Connectors:

AASHTO M169 (ASTM A108), $F_y = 50 \text{ ksi}$, $F_u = 60 \text{ ksi}$

LRFD 6.4.4

1.2 Girder Limits and Preferences

There are situations to consider when deciding to choose between a wide flange or plate girder design.

- Curved structures or structures requiring severe camber, are more typical for welded plate girders.
- The designer should check the availability of standard wide flange shapes.
- Typically if wide flanges are capable for the design, a wide flange beam design will be more economical than a welded plate girder.

Maximum Section Length

LRFD C6.10.3.4

Maximum girder section length shall be limited to meeting:

- Flange shipping and erection limit of $b_f > L/85$, where b_f = flange width and L = section length.
- Site accessibility restrictions (consult with District)

Minimum Plate Length

10 ft. Shop flange splices should be eliminated and extra plate material used when economy indicates and span lengths permit.

Stiffeners

Longitudinal stiffeners are generally not economical in spans less than 300 ft.

The number of different sizes of transverse stiffeners should be reduced to a minimum for stiffener widths up to 8". This is because small plate materials of any thickness and up to 8" in width must be ordered by fabricators as bars in 20 ton lots for each size. (A "bar" is generally a plate 8" wide or less).

Web Depth

It is preferred to use web depths in 6" increments. Other increments may be used when required by the Design Layout (See Structural Project Manager). Note that Standard Web Splice Tables in LRFD DG Sec. 3.43.3 are provided in 2" web depth increments.

In the absence of LRFD-specific data, the following information is provided. Three spans with ratio $n = 1.3 \pm$ and HS20 live load were considered.



Figure 3.43.1.2.1 Three-Span Structure

Table 3.43.1.2.1 Continuous Girders, HS20, ASTM A709 Gr. 36

Span estimate, L (ft)	Est. Web Depth (in)
85 to 99	42
100 to 119	48
120 to 129	54
130 to 144	60
145 to 154	66
155 to 169	72
170 to 179	78
180 to 189	84
190 to 200	90

Table 3.43.1.2.2 Continuous Girders, HS20, ASTM A709 Gr. 50

Span estimate, L (ft)	Web Depth (in)
85 to 104	42
105 to 124	48
125 to 134	54
135 to 144	60
145 to 159	66
160 to 174	72
175 to 179	78
185 to 189	84
195 to 204	90

Web thickness

LRFD 6.10.2.1

Minimum web thickness for plate girders = 1/2"
 Web thickness increment is 1/16 inch.

Transverse stiffeners may be omitted when indicated by design and economy. A cost comparison can be made based on current average bid prices that may be obtained from the Structural Project Manager for comparable bridges.

Because of their fabrication expense, it is usually economical to increase web thickness by 1/16 inch to eliminate all but a few transverse stiffeners. It will usually be economical to eliminate transverse stiffeners for shallow webs (36" to 42"). A general rule of thumb is to determine the minimum web thickness without stiffeners; then, use a web thickness 1/16 inch less.

Flanges

LRFD 6.10.2.2

Minimum flange dimensions are $3/4" \times 12"$. For shipping and erection purposes, minimum width of both compression and tension flanges shall not be less than $L/85$, where L is the shipping length of the girder section. This limitation is to prevent out-of-plane distortion of the girder.

LRFD Table 6.4.1-1

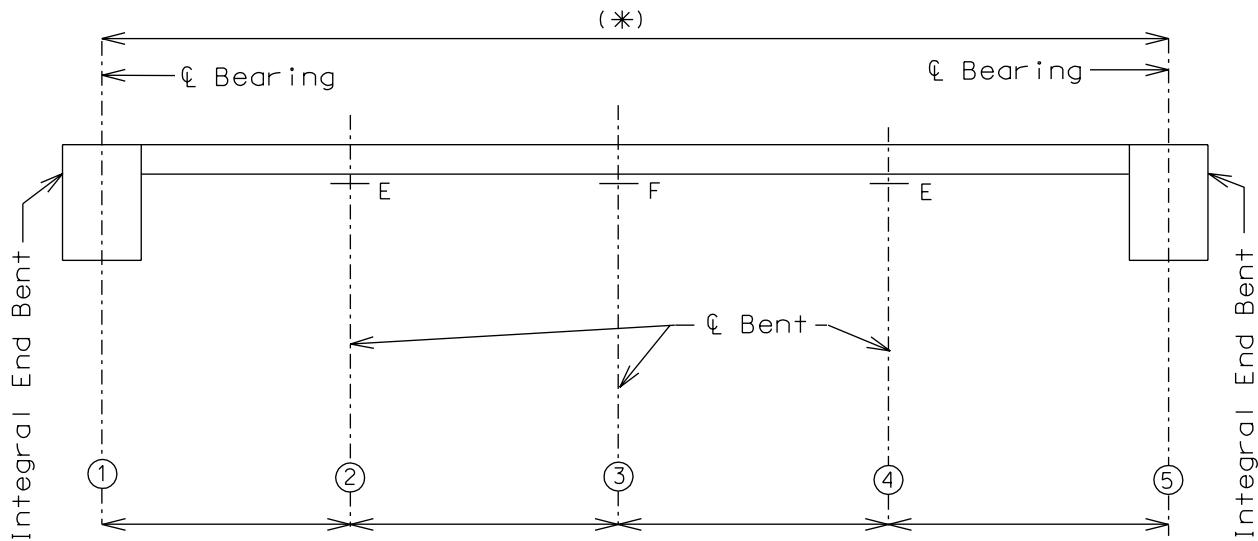
Maximum flange thickness = 4", except for HPS70W limitations.

Flange thickness increment is 1/8 inch. Flange width increment is 1 inch.

Note that flange transitions may be economical if the flange thickness is constant and the flange width is varied since the flanges could be cut from the same plate material. If the flange width is held constant and the flange thickness is varied, then economy could result if welded butt splices were permitted.

Structure Length

Typical Continuous Steel Structures – Integral End Bents:



(*) Maximum length from End Bent to End Bent = 500 feet.

1.3 Girder Spacing on Non-Standard Roadways

Several items shall be considered when determining the girder spacing for non-standard roadways:

General Guidelines

In general, an economical girder arrangement is one that:

Balance M & V Distribution Factors. For efficiency, it is desired for all girders to be designed for the same loads, resulting in the same section for exterior and interior girders.

Practical Constraints

Some practical constraints to consider when optimizing girder spacing:

Number of girders. For consideration of future stage construction, there may be a minimum number of girders that should be considered.

Maximum Precast Panel Span. Since precast panels are the standard, the panel span limit in LRFD DG Sec. 3.30.2.1 should not be exceeded. For cases where CIP option is used in lieu of panels, it is generally recognized that 12 ft girder spacing is a maximum practical limit to allow for future redecking.

Vertical Clearance and Deflection Requirements. It is expected that fewer girder lines would result in deeper girders. Vertical clearance or deflection constraints may dictate the use of more girder lines than optimum, or a shallower web than optimum.

LRFD 4.6.2.2.1

Slab Overhang Limits. In order to use distribution factors provided in LRFD Table 4.6.2.2.2 for girder design, the roadway overhang shall not exceed 3 ft. otherwise the structure shall be analyzed with Refined Methods of Analysis specified in LRFD 4.6.3.

3.43.2 Design

2.1 Limit States and Load Factors

In general, each component shall satisfy the following equation:

LRFD 1.3.2.1

$$Q = \sum \eta_i \gamma_i Q_i \leq \phi R_n = R_r$$

Where:

Q = Total factored force effect

Q_i = Force effect

η_i = Load modifier

γ_i = Load factor

ϕ = Resistance factor

R_n = Nominal resistance

R_r = Factored resistance

LRFD 6.5

Limit States

The following limit states shall be considered for steel superstructure design:

STRENGTH – I

STRENGTH – III

*STRENGTH – IV**

STRENGTH – V

SERVICE – II

FATIGUE

CONSTRUCTION

LRFD 3.4.2

LRFD C3.4.1

*Use for bridges with high DL to LL ratios. Typically, bridges with spans > 200 ft.

See LRFD Table 3.4.1-1 and LRFD 3.4.2 for Loads and Load Factors applied at each given limit state.

Resistance factors

STRENGTH limit states, see LRFD Article 6.5.4.2

For all other limit states, $\phi = 1.00$

LRFD 1.3.2.1

Load Modifiers

For loads where a maximum value of load factor is appropriate:

$$\eta = (\eta_I \eta_R \eta_D) \geq 0.95$$

For loads where a minimum value of load factor is appropriate:

$$\eta = 1 / (\eta_I \eta_R \eta_D) \leq 1.0$$

Where:

η_D = Factor relating to ductility

η_R = Factor relating to redundancy

η_I = Factor relating to operational importance

Table 3.43.2.1 Load modifiers

	All Limit States
Ductility, η_D	1.0
Redundancy, η_R	1.0
Operational importance, η_I	1.0
$\eta = (\eta_I \eta_R \eta_D)$	1.0
$\eta = 1 / (\eta_I \eta_R \eta_D)$	1.0

2.2 Analysis Methods

MoDOT office practice generally utilizes the following:

The elastic stress at any location on the composite section due to the applied loads shall be the sum of the stresses caused by the loads applied separately at the following three stages:

LRFD 6.10.1.1a

Non-Composite Stage – The dead load of slab and haunching and stringer self weight shall be analyzed at this stage. This stage shall also be used for any construction loading checks. The section properties used are of the steel section only.

Long Term Composite Stage – The dead load of barrier curb, future wearing surface and any other appurtenances shall be analyzed at this stage. The section properties used are of the composite section of slab and stringer assuming an elastic modulus of $3n$ for the slab. Where “ n ” is the modular ratio.

Short Term Composite Stage – Any live loading shall be analyzed at this stage. The section properties used are of the composite section of slab and stringer assuming an elastic modulus of “ n ” for the slab. Where “ n ” is the modular ratio.

LRFD 6.10.1.1

Composite regions shall be defined as regions where shear connectors are used to connect the steel section to a concrete deck. Simple spans are designed as composite throughout.

Compact Section

Compact Design will be allowed if holes drilled in tension flange are investigated for LRFD 6.10.1.8 Net Section Fracture.

Wind

LRFD 4.6.2.7.1

For girder and intermediate diaphragm and cross-frame design, wind acting on the top half of girder is distributed to deck and wind on the lower half is assumed to be carried by the bottom girder flange.

2.3 Intermediate Diaphragms and Cross Frames

General

Cross frames are located at all intermediate bents with continuous slabs.

LRFD 6.7.4.2

Diaphragms or cross-frames for rolled beams shall be at least $\frac{1}{2}$ the beam depth.

LRFD 6.7.4.1

Diaphragms or cross-frames shall be investigated for all stages of assumed construction procedures and the final condition.

Investigation shall include, but not be limited to:

- Transfer of lateral wind loads from the bottom of the girder to the deck and from the deck to the bearings.
- Stability of the bottom flange for all loads when it is in compression
- Stability of the top flange in compression prior to curing of the deck

Straight Girders

Typically the maximum intermediate diaphragm spacing shall be 25'-0", unless determined otherwise for special designs.

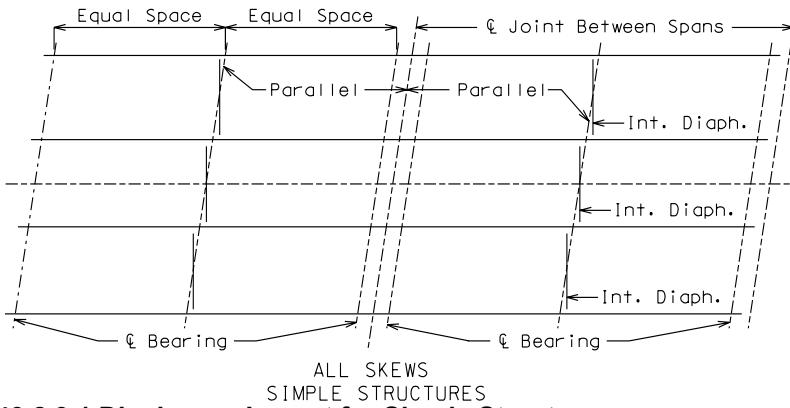


Figure 3.43.2.3.1 Diaphragm Layout for Simple Structures

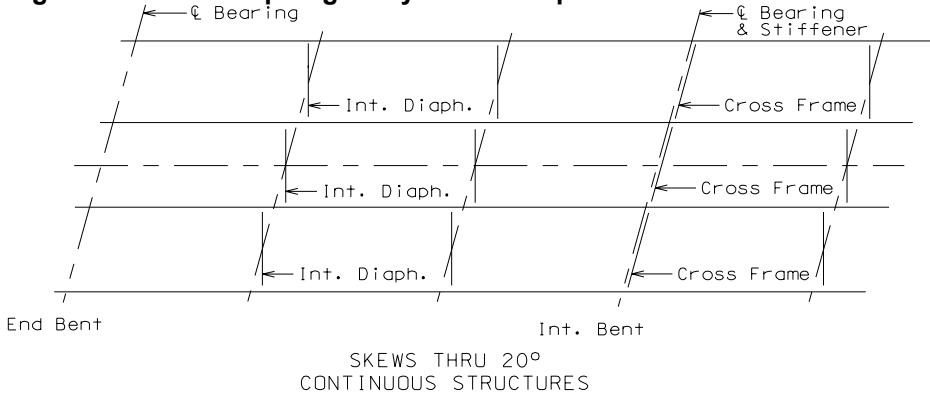


Figure 3.43.2.3.2 Diaphragm Position for Continuous Structures with Skews Thru 20 Degrees

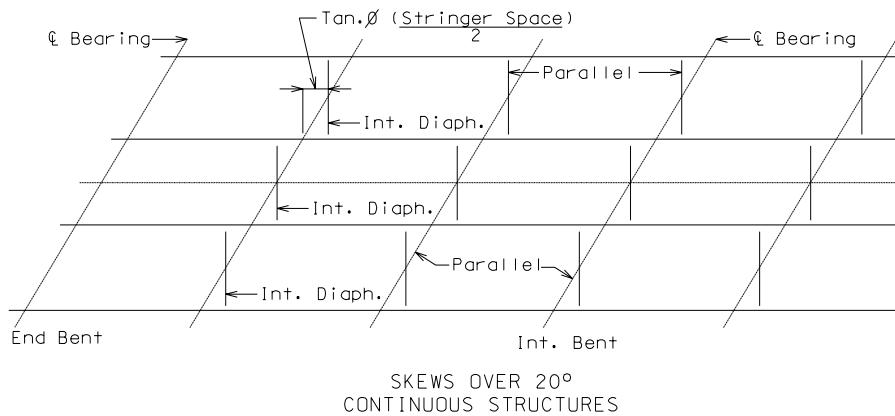


Figure 3.43.2.3.3 Diaphragm Position for Continuous Structures with Skews Over 20 Degrees

Curved Girders

Maximum intermediate diaphragm spacing shall be 25'-0", unless a lesser spacing is warranted by design.

Diaphragms shall be positioned radially and in line, except in bridges having extreme skews. Many different diaphragm spacing arrangements are possible. Attach diaphragm to a bearing stiffener where possible. The proposed diaphragm layout shall be reviewed with the Structural Project Manager prior to detailing on the plans.

A sketch of the desired diaphragm layout is given below. Special design will be required for diaphragms when the degree of curvature exceeds 3 degrees or when span length exceeds 70 ft.

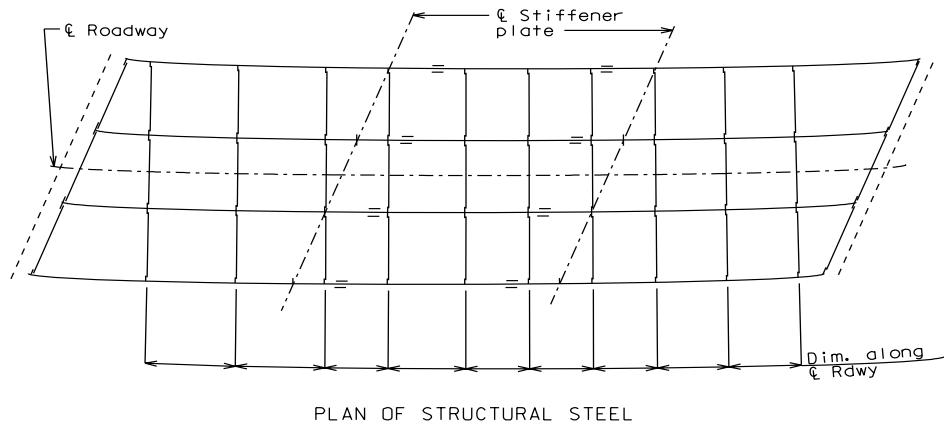


Figure 3.43.2.3.4 Desired Diaphragm Layout for Curved Stringers

2.4 End Diaphragms

General

Steel end diaphragms shall be located at all non-integral end bents and intermediate bents where continuity of the slab is broken (i.e. expansion joints). Integral end bent shall use a concrete diaphragm

LRFD 6.7.4.2

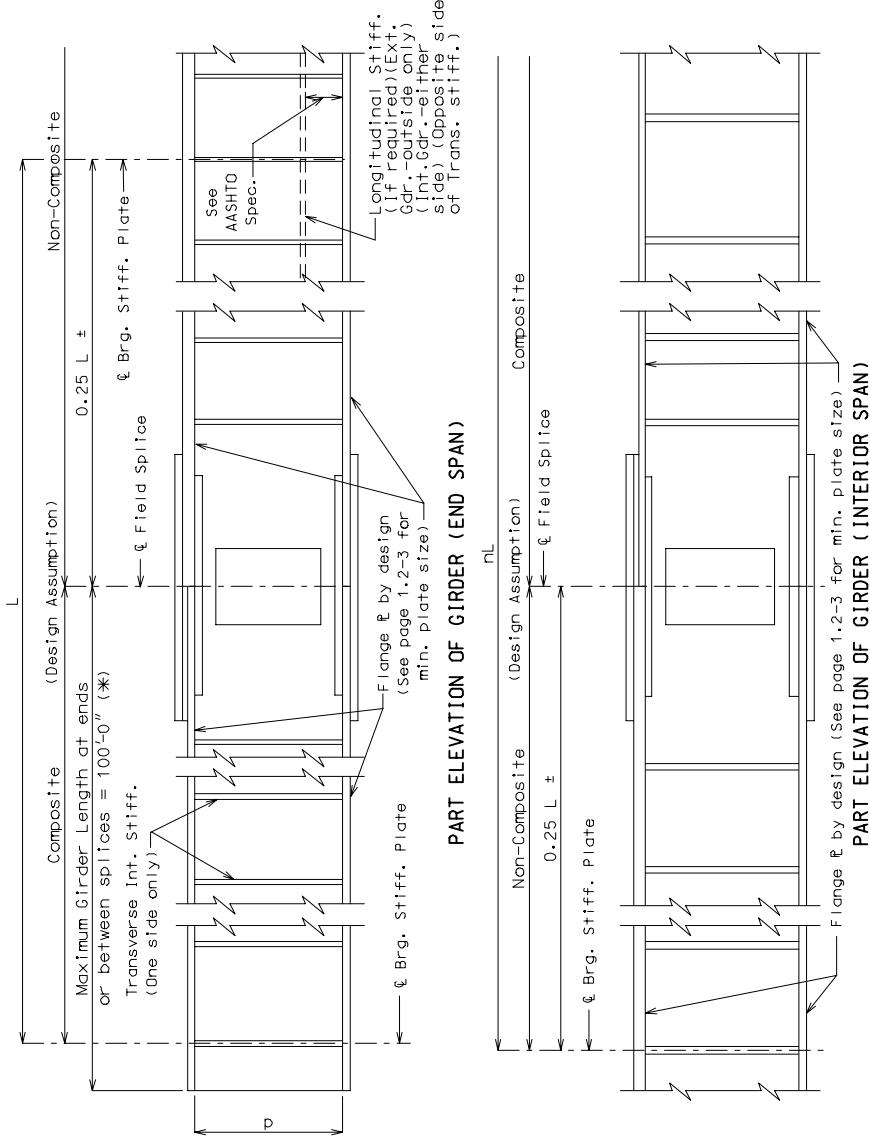
Steel diaphragms for rolled beams shall be at least $\frac{1}{2}$ the beam depth.

LRFD 6.7.4.1

Steel diaphragms shall be investigated for all stages of assumed construction procedures and the final condition. Investigation shall include, but not be limited to:

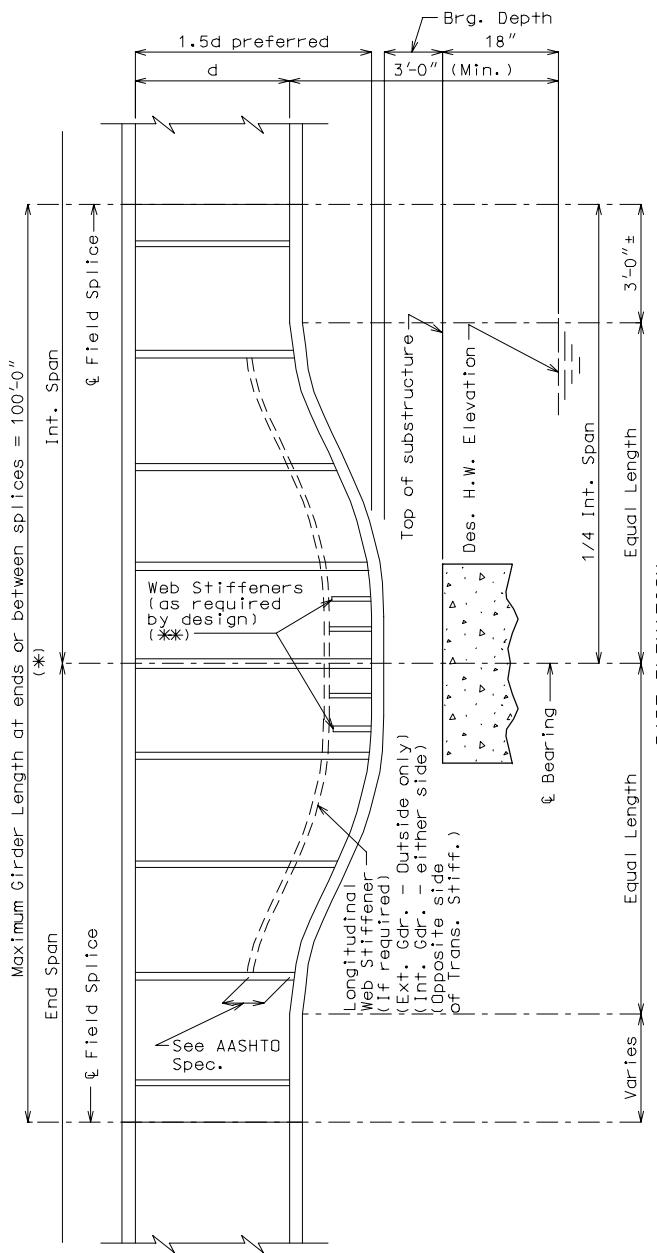
- Transfer of lateral wind loads from the bottom of the girder to the deck and from the deck to the bearings.
- Stability of the bottom flange for all loads when it is in compression
- Stability of the top flange in compression prior to curing of the deck
- Distribution of vertical dead and live loads applied to the structure. (*)

(*) At the end of the bridge and intermediate points where the continuity of the slab is broken, the edges of the slab shall be supported by diaphragms or other suitable means as specified in LRFD 9.4.4. Top horizontal members shall be designed for vertical live and dead loads.



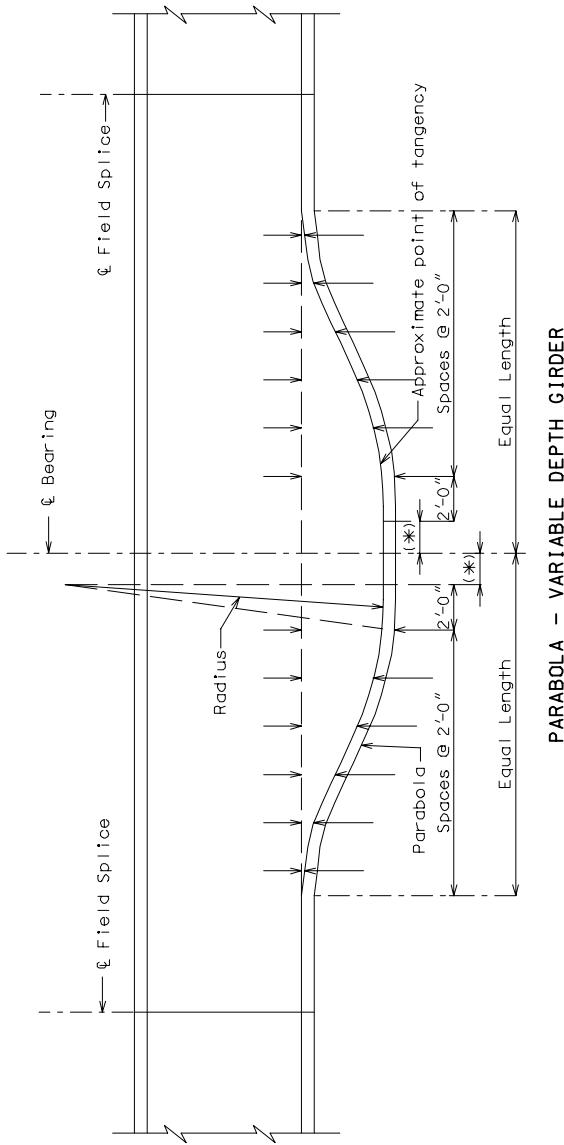
*) See Structural Project Manager for approval to deviate from the Maximum Girder Length of plate girder sections.

Part Elevation of Variable Depth Girder - Plate Girder Only Design



Use Variable depth section only as specified on Design Layout Sheet. Consult the Structural Project Manager for consideration of constant depth section in lieu of variable depth section based on design references or structural adequacy.

- (*) See Structural Project Manager for approval to deviate from the Maximum Girder Length of plate girder sections.
- (**) See Design of Welded Structures by The James F. Lincoln Arc Welding Foundation, page 5.11-19.

**PARABOLA - VARIABLE DEPTH GIRDER**

(*) Use 12" except for girders having bottom flange plate over 1-1/2" in thickness, then use 18".

2.6 Other Requirements

Deflection

LRFD 2.5.2.6.2

For allowable live load deflection, see Section 1.2 Page 4.2-1. (The deflection limits indicated are an attempt to ensure that LRFD provides a structure that will meet or exceed current MoDOT LFD deflection criteria.)

Compute at 1/4 points for bridges with spans < 75 ft,
Compute at 1/10 points for spans \geq 75 ft.

Deflection shall be based on deflection distribution factor and loading specified in LRFD DG Sec. 1.2.4.2.

Minimum Negative Flexure Deck Reinforcement

LRFD 6.10.1.7

See LRFD DG Sec. 2.4.

Bearing Stiffeners

- Bearing stiffener width shall be given in $\frac{1}{2}$ " increments and shall extend to within a $\frac{1}{2}$ " of the bottom flange.
- Bearing stiffener thickness shall be given in $\frac{1}{8}$ " increments.
- If the skewed stiffener option is used, make stiffeners on both sides of web for skew thru 45° the same size as the larger except in cases where overhang would be produced. This does not apply to end bearing stiffeners for skew over 45° .

Diaphragms and Cross-Frames

LRFD 6.7.4.1

Diaphragms and cross-frames and their connections shall:

- Meet all applicable limit states for the calculated force effects.
- Follow *LRFD 4.6.2.7* for transfer of wind loads
- Meet slenderness requirements of *LRFD 6.8.4* or *6.9.3*
- Meet connection plate design requirements of *LRFD 6.6.1.3.1*
- Be designed for stability of top flange in compression during noncomposite stage, and bottom flange for all loads when in compression.

Top horizontal members in end diaphragms shall be designed for vertical live load and dead loads.

3.43.3 Splice Design

3.1 Field Bolted Splice Design

General

In continuous spans, splices should be made at or near points of dead load contraflexure excluding future wearing surface. Web and Flange splices in areas of stress reversal shall be investigated for both positive and negative flexure.

LRFD 6.13.6.1.4a

In both web and flange splices, there shall not be less than two rows of bolts on each side of the joint. Oversize or slotted holes shall not be used in either the member or the splice plates at bolted splices.

Bolted splices for flexural members shall be designed using slip-critical connections as specified in LRFD 6.13.2.1.1. The connections shall also be proportioned to prevent slip during the erection of the steel and during the casting of the concrete deck.

The tensile stress on the flange should be checked for net fracture per LRFD 6.10.1.8.

In bolted slip-critical connections subject to shear, the load is transferred between the connected parts by friction up to a certain level of force that is dependent upon the total clamping force on the faying surfaces and the coefficient of friction of the faying surfaces. As loading is increased to a level in excess of the frictional resistance between the faying surfaces, slip occurs, but failure in the sense does not occur. As a result, slip critical connections are able to resist even greater loads by shear and bearing against the connected material. The strength of the connection is not related to the slip load. Slip resistance, shear resistance and bending shall be computed separately. Any potential greater resistance due to combined effect is ignored.

Bolt Design

Slip Resistance

LRFD 6.13.2.8

Splices shall be designed as slip critical connections with Class B surface preparation and standard holes. Slip shall be checked against the maximum of the Service-II limit stresses and the Strength-I construction stresses due to slab pouring sequences. All splice bolts shall be 7/8" diameter ASTM A325 high strength bolts with a minimum pretension of 39 kips upon girder erection.

Shear Resistance

LRFD 6.13.2.7

The Bolt Shear Resistance shall be adequate to resist loads at the Strength-I limit state. (see Loads section under Flange Splice Plate Design)

If a filler plate not less than 0.25" in thickness is used in a flange splice then the Bolt Shear Resistance shall be reduced by the following factor:

LRFD 6.13.6.1.5

$$R = \frac{(1 + \gamma)}{(1 + 2\gamma)}$$

where:

$$\gamma = \frac{A_f}{A_p}$$

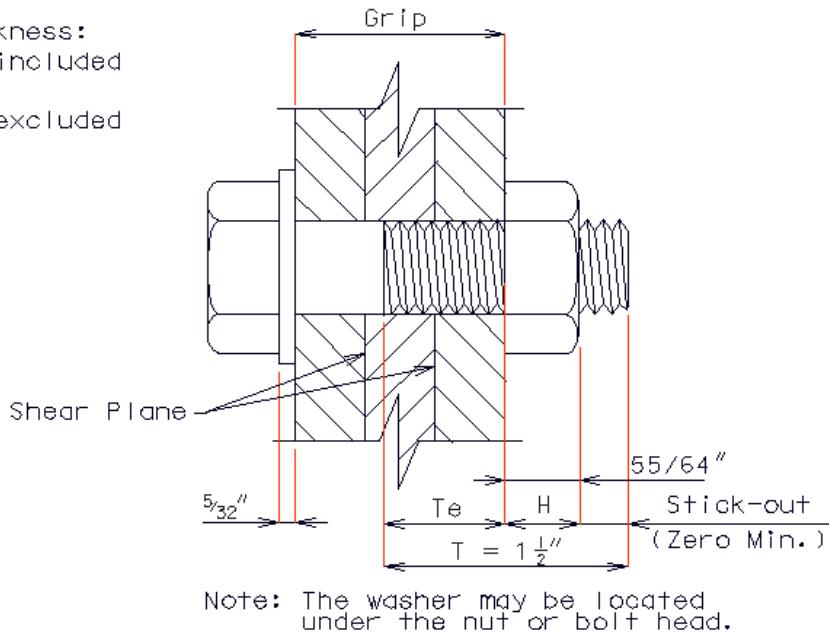
A_f = sum of the area of the fillers on the top and bottom of the connected plate (in^2)

A_p = smaller of either the connected plate area or the sum of the splice plate areas on the top and bottom of the connected plate (in^2)

If the distance between extreme fasteners on one side of a flange splice (joint length) is greater than 50 inches then the Bolt Shear Resistance shall be reduced by 20%. Excluding the threads from the shear plane (when applicable) in order to reduce the overall length of a joint is preferred over reducing the Bolt Shear Resistance for large joint lengths.

Min. splice plate thickness:
 $\leq \frac{5}{8}''$ \Rightarrow Bolt threads included

$\geq \frac{3}{4}''$ \Rightarrow Bolt threads excluded



Note: The washer may be located under the nut or bolt head.

Figure 3.43.3.1 Critical dimensions for checking thread exclusion in 7/8" diameter high strength bolted connections.

As shown in Figure 3.43.3.1, threads may be excluded from the shear plane when the minimum splice plate thickness at the joint is greater than 5/8". Otherwise, the bolt threads shall be assumed to be included in the shear plane.

Thread Embedment, $T_e = T - H - \text{washer height} - (\text{stick-out})$

$$T_{e, \max} = 1.5'' - 55/64'' - 0'' - 0'' = 0.641'' \text{ or } 3/4'' \text{ rounded up to the nearest } 1/8''.$$

Flange Bolt Patterns

The minimum distance from the center of any fastener in a standard hole to a sheared or thermally cut edge shall be 1-1/2 inches for 7/8" diameter fasteners. The minimum distance between centers of fasteners in standard holes shall be three times the diameter of the fastener, but shall not be less than 3 inches parallel to the line of force for 7/8" diameter fasteners. The minimum edge distance shall be 2 inches for top flange outer splice plates to allow for panel clearance.

Uniform bolt patterns are preferred in all cases except that a staggered pattern may be used for flanges that are 14 and 15 inches wide. A staggered bolt pattern reduces the distance between rows of bolts so panels can be placed along the edges of the plate.

Bolt tightening clearances may become a problem for thick flanges. Generally, if the flange inner splice plate thickness is less than 1.5" then construction clearances can be assumed to be adequate. Otherwise, a thorough review is required to ensure that a 2.5" diameter socket with 1/16" clearance can be used. If the inner splice plate thickness cannot be reduced the web bolt pattern can be modified.

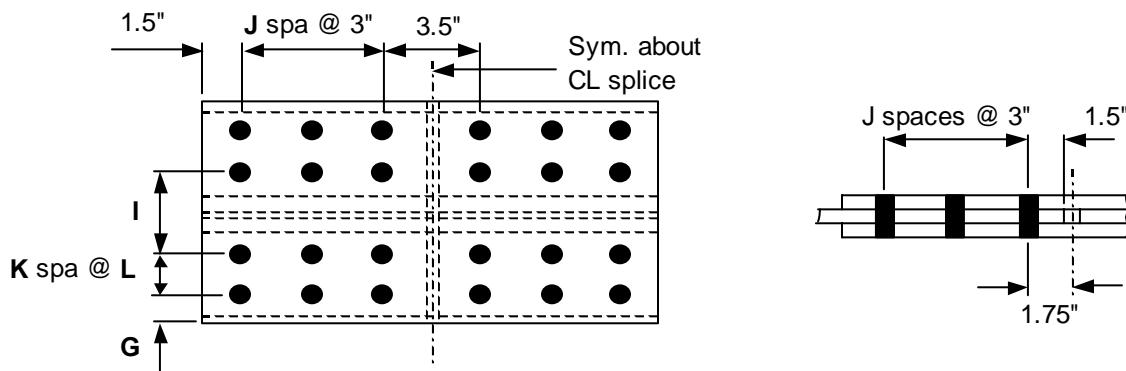
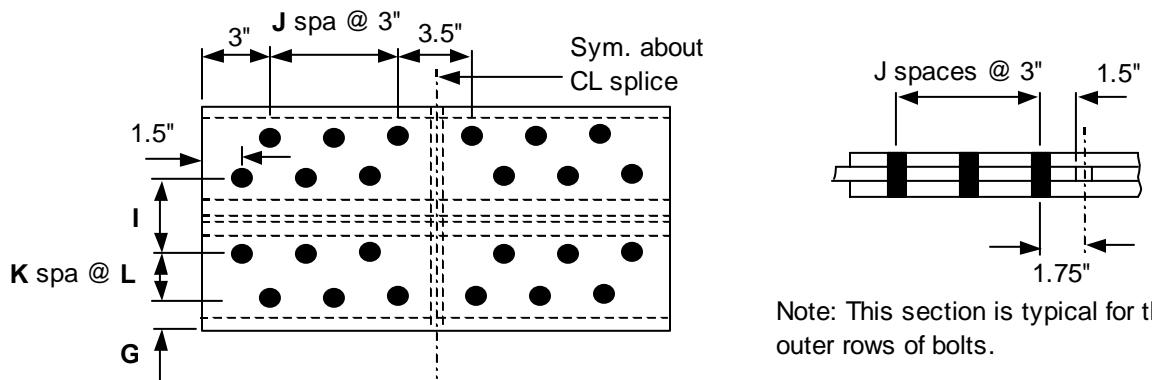


Figure 3.43.3.2 Uniform Bolt Pattern



Note: This section is typical for the outer rows of bolts.

Figure 3.43.3.3 Staggered Bolt Pattern

Flange Splice Plate Design

Flange Width Transitions

When the width of the flanges being spliced differs by more than 2", the larger flange shall be beveled as shown in Figure 3.43.3.4.

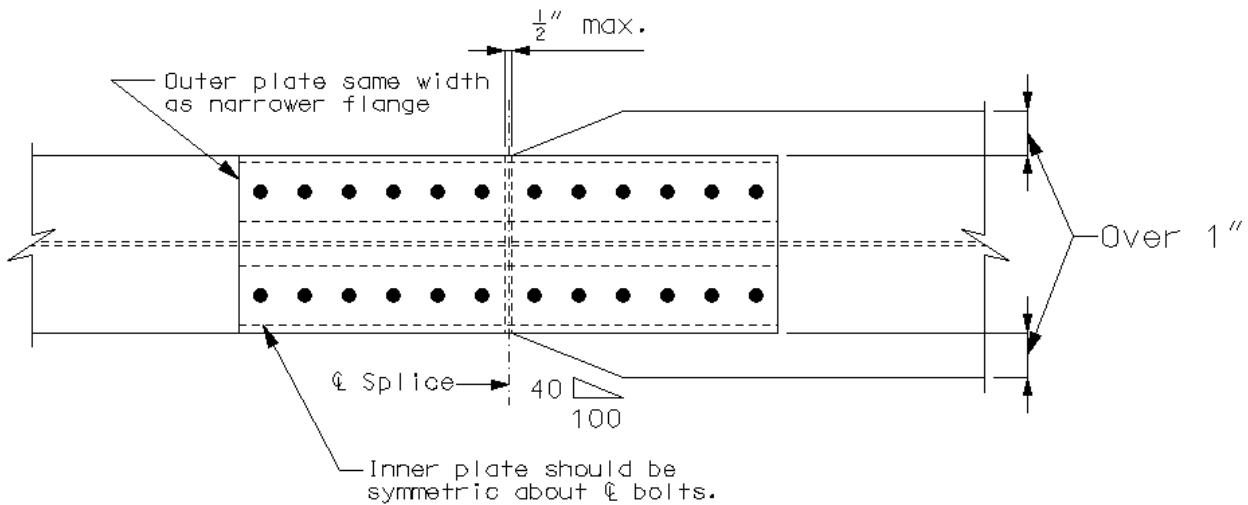


Figure 3.43.3.4 Flange Width Transition at splice

Flange Splice Plate Design (cont.)

Flange Splice Dimensions

1. Minimum thickness of splice plate = 3/8"
2. Splice plate thickness increment = 1/8"
3. At the strength limit state, if the gross areas of the outer and inner splice plates vary by less than 10% then the shear force can be distributed by double shear. Otherwise, the shear force must be distributed to each shear plane by the percentage of the gross area of the plate in contact with the shear plane from the total gross area of splice plates. (Note: Double shear can be assumed at the service limit state for all cases)
4. The total gross area of the splice plates shall be greater than the gross area of the smaller flange.
5. Bolt holes are considered to be 1" in diameter for the purpose of determining the net flange or splice area.
6. Inner splice plates shall be symmetric for uniform bolt patterns.

LRFD C6.13.6.1.4c

LRFD 6.13.6.1.4c

LRFD 3.4.2

Loads

- **Strength I** - Splice plates shall be designed to resist a minimum design stress equal to the average of the factored elastic flexural stress at the mid-depth of the flange and the yield strength of the flange (F_y), but shall not be less than $0.75F_y$.
- **Service II** – Use factored loading to determine design force.
- **Construction** – Use factored loading to determine design force.
- **Fatigue** – Use factored loading to determine design stress range.

Resistance

The nominal flexural resistance (F_n) of the flange at the point of splice at the strength limit state shall be assumed to be equal to the specified minimum yield strength of the flange (F_{yf}). For hybrid sections, a hybrid factor (R_h) shall be used to increase the stress seen by the flange when the factored elastic flexural stress exceeds F_{yw} at the top or bottom of the web.

Flange splice plates shall be checked for:

- Tensile Resistance @ Strength-I Limit State
 - Yielding of Gross Section
 - Fracture of Net Section
 - Block Shear Rupture of Net Section
 - Compressive Resistance @ Strength-I Limit State
 - Fatigue Resistance @ Fatigue and Fracture Limit State
 - Permanent Deflection under Construction loads
- Note: The last two checks may be ignored if the sum of the gross splice plate areas is greater than the gross area of the flange.*

Girder flange shall be checked for:

- Tensile Resistance @ Strength-I Limit State
 - Fracture of Net Section
 - Block Shear Rupture of Net Section
 - Bearing Resistance @ Strength-I Limit State

LRFD 6.8.2

LRFD 6.13.5.2

LRFD 6.13.4

LRFD 6.13.6.1.4c

LRFD 6.6.1.2.5

LRFD 6.10.4.2.2

LRFD 6.13.5.2

LRFD 6.13.4

LRFD 6.13.2.9

Web Splice Plate Design

Web Splice Dimensions

1. Webs shall be spliced symmetrically by plates on each side.
2. These plates shall extend as near as practical for the full depth between flanges.
3. The thickness of the web splice plates shall be 3/8". The total gross area of the splice plates shall be greater than the gross area of the smaller web at splice.
4. Bolt holes are considered to be 1" in diameter for the purpose of determining the net web or splice area.

Loads

LRFD 6.13.6.1.4b

Web splice plates and their connections shall be designed for shear, the moment due to the eccentricity of the shear at the point of splice, and the portion of the flexural moment assumed to be resisted by the web at the point of splice.

- **Strength I** - If $V_u > 0.5V_r$, then the design shear (V_{uw}) shall be equal to the average of the factored shear loading (V_u) and the factored shear resistance (V_r) of the smaller web. Otherwise, $V_{uw} = 1.5V_u$. The design moment shall be calculated using the design stresses determined for flange design.
- **Service II** – Use the factored loading to determine the design shear and moment.
- **Construction** – Use the factored loading to determine the design moment and shear.
- **Fatigue** – Use the factored loading to determine the design stress range.

Resistance

The factored shear resistance (V_r) of the web shall be determined as specified in LRFD 6.12.1.2.3. For hybrid sections the web shall resist only the stress not exceeding the yield strength of the web (F_{yw}). A hybrid factor (R_h) shall be used to reduce the stress seen by the web when the factored elastic flexural stress exceeds F_{yw} at the top or bottom of the web.

Web splice plates shall be checked for:

- Tensile Resistance @ Strength-I Limit State
 - Yielding of Gross Section
 - Fracture of Net Section
 - Block Shear Rupture of Net Section
 - Flexural Resistance @ Strength-I Limit State
 - Fatigue Resistance @ Fatigue and Fracture Limit State
 - Permanent Deflection under construction loads

Note: The last two checks may be ignored if the sum of the gross splice plate areas is greater than the gross area of the web.

Girder web shall be checked for:

Bearing Resistance @ Strength-I Limit State

LRFD 6.13.2.9

Design Tools

Field Flange Splice Tables

The flange tables were developed assuming a symmetric girder section with the tension flange near yield. The flange splice plates were designed to carry this tension force along with the associated compression force found on the opposing flange. Net fracture of the flange is eliminated by limiting the factored tensile stress, f_t , to the maximums allowed in Table 3.43.3.1.1. When the flange section or steel grade changes at a splice, use the narrower flange. For flanges with the same width, the smaller flange strength may be used from the table as shown below.

Which flange should be used to enter in the tables?

A. Grade 50W – 18" x 2" vs. B. Grade 70W – 18" x 1.375"
50ksi x 18" x 2" = 1800 k > 70ksi x 18" x 1.375" = 1733 k

. . . Use Flange B from the table (50W splice plate)

Field Web Splice Tables

The dimensions of the web splices shown in the tables are based on the assumption that the factored shear force (V_u) is equal to the web's unstiffened shear capacity (V_r). Also, the moment required to be resisted by the web (M_u) is assumed to be half of the elastic web moment capacity ($0.5M_{cap}$). If the design shear (V_{uw}) is greater than the unstiffened shear capacity, V_r , (i.e. stiffened webs) then the web splice shall be designed in accordance with LRFD 6.13.6.1.4b.

Flange splices shall be checked to ensure that they can resist the entire moment applied to the girder section at the centerline of the splice, or the web and flange splices will have to be designed in accordance with LRFD 6.13.6.1.4b & c.

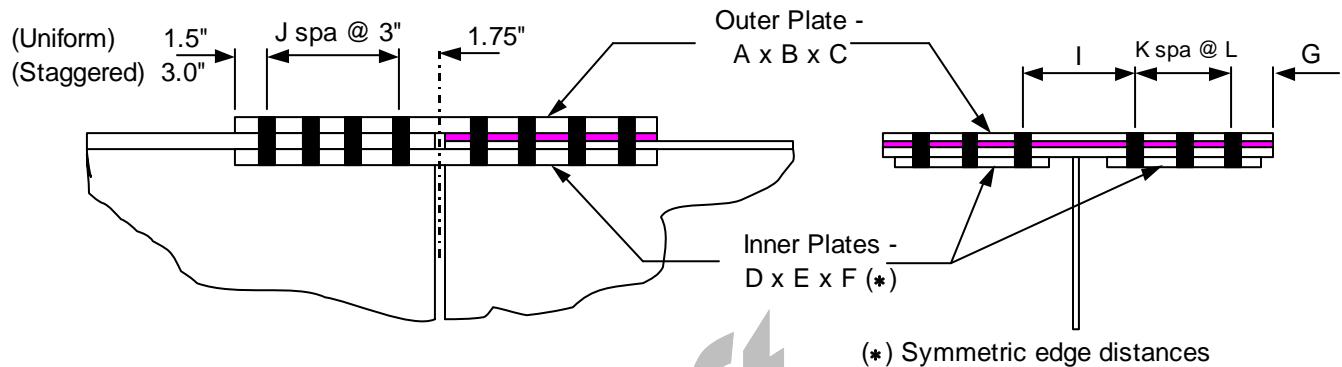
Table 3.43.3.1.1 – Maximum allowable gross tensile stress in flange at splice per LRFD 6.10.1.8.*

Flange Width	Flange Grade		
	50	50W	70W
12"	45.5	49.0	63.0
13"	46.2	49.7	64.0
14"	46.0	49.6	63.7
15"	46.6	50	64.5
16"	40.9	44.1	56.7
17"	41.7	45.0	57.8
18"	42.5	45.7	58.8
19"	43.1	46.4	59.7
20"	43.7	47.0	60.5
21"	44.2	47.6	61.2
22"	39.7	42.8	55.0
23"	40.4	43.5	55.9
24"	40.9	44.1	56.7

*Lower stresses will not fracture the net section when using the Flange Splice tables. Maximum stresses are dependant on bolt pattern.

3.2 Plate Girder - Flange Splice Tables

FLANGE PLATE SIZE: 12" thru 24" (2, 4 or 6 rows of Bolts)
ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splice



Note: For staggered bolt patterns the spacing shown above is for the edge rows of bolts.

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J (in)	K (in)	L (in)	Total # of Bolts	
12 x 3/4"	< 1/4"	12	0.500	36.5	4	0.625	36.5	3	6	5	0	0	24	136.7
	other	12	0.500	54.5	4	0.625	54.5	3	6	8	0	0	36	204.2
12 x 7/8"	< 1/4"	12	0.625	42.5	4.5	0.625	42.5	2.75	6.5	6	0	0	28	184.8
	other	12	0.625	60.5	4.5	0.750	60.5	2.75	6.5	9	0	0	40	282.5
12 x 1"	< 1/4"	12	0.625	42.5	4.5	0.750	42.5	2.75	6.5	6	0	0	28	198.3
	other	12	0.625	66.5	4.5	0.750	66.5	2.75	6.5	10	0	0	44	310.5
12 x 1-1/8"	< 1/4"	12	0.750	42.5	5	0.750	42.5	2.5	7	6	0	0	28	225.4
	other	12	0.750	60.5	5	0.750	60.5	2.5	7	9	0	0	40	321.1
12 x 1-1/4"	< 1/4"	12	0.750	48.5	5	0.750	48.5	2.5	7	7	0	0	32	257.3
	other	12	0.750	66.5	5	0.750	66.5	2.5	7	10	0	0	44	352.9
12 x 1-3/8"	< 1/4"	12	0.875	54.5	5	0.875	54.5	2.5	7	8	0	0	36	331.7
	other	12	0.875	66.5	5	1.000	66.5	2.5	7	10	0	0	44	428.4
12 x 1-1/2"	< 1/4"	12	0.875	54.5	5	1.000	54.5	2.5	7	8	0	0	36	351.0
	other	12	0.875	66.5	5	1.000	66.5	2.5	7	10	0	0	44	428.4
12 x 1-5/8"	< 1/4"	12	1.000	54.5	5	1.125	54.5	2.5	7	8	0	0	36	393.5
	other	12	1.000	66.5	5	1.125	66.5	2.5	7	10	0	0	44	480.2
12 x 1-3/4"	< 1/4"	12	1.000	60.5	5	1.125	60.5	2.5	7	9	0	0	40	436.9
	other	12	1.000	72.5	5	1.125	72.5	2.5	7	11	0	0	48	523.6
12 x 1-7/8"	< 1/4"	12	1.125	66.5	5	1.250	66.5	2.5	7	10	0	0	44	532.1
	other	12	1.125	72.5	5	1.250	72.5	2.5	7	11	0	0	48	580.1
12 x 2"	< 1/4"	12	1.250	66.5	5	1.375	66.5	2.5	7	10	0	0	44	583.9
	other	12	1.250	78.5	5	1.375	78.5	2.5	7	12	0	0	52	689.4
12 x 2-1/8"	< 1/4"	12	1.250	72.5	5	1.375	72.5	2.5	7	11	0	0	48	636.7
	other	12	1.250	84.5	5	1.375	84.5	2.5	7	13	0	0	56	742.1
12 x 2-1/4"	< 1/4"	12	1.375	78.5	5	1.500	78.5	2.5	7	12	0	0	52	750.6
	other	12	1.375	90.5	5	1.500	90.5	2.5	7	14	0	0	60	865.4

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-2

Splice Design

Field Flange Splice Tables (Cont.)

ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
13 x 3/4"	< 1/4"	13	0.500	36.5	4	0.750	36.5	3.5	6	5	0	0	24	152.2
	other	13	0.500	54.5	4	0.750	54.5	3.5	6	8	0	0	36	227.4
13 x 7/8"	< 1/4"	13	0.625	42.5	4.5	0.750	42.5	3.25	6.5	6	0	0	28	205.9
	other	13	0.625	66.5	4.5	0.875	66.5	3.25	6.5	10	0	0	44	343.5
13 x 1"	< 1/4"	13	0.625	48.5	4.5	0.875	48.5	3.25	6.5	7	0	0	32	250.4
	other	13	0.625	72.5	4.5	0.875	72.5	3.25	6.5	11	0	0	48	374.5
13 x 1-1/8"	< 1/4"	13	0.750	48.5	5	0.875	48.5	3	7	7	0	0	32	284.8
	other	13	0.750	66.5	5	0.875	66.5	3	7	10	0	0	44	390.7
13 x 1-1/4"	< 1/4"	13	0.750	48.5	5	0.875	48.5	3	7	7	0	0	32	284.8
	other	13	0.750	66.5	5	0.875	66.5	3	7	10	0	0	44	390.7
13 x 1-3/8"	< 1/4"	13	0.750	54.5	5	1.000	54.5	3	7	8	0	0	36	339.4
	other	13	0.750	66.5	5	1.000	66.5	3	7	10	0	0	44	414.2
13 x 1-1/2"	< 1/4"	13	0.875	54.5	5	1.125	54.5	3	7	8	0	0	36	383.9
	other	13	0.875	72.5	5	1.125	72.5	3	7	11	0	0	48	510.7
13 x 1-5/8"	< 1/4"	13	1.000	60.5	5	1.250	60.5	3	7	9	0	0	40	475.5
	other	13	1.000	72.5	5	1.250	72.5	3	7	11	0	0	48	569.8
13 x 1-3/4"	< 1/4"	13	1.000	66.5	5	1.250	66.5	3	7	10	0	0	44	522.7
	other	13	1.000	78.5	5	1.250	78.5	3	7	12	0	0	52	617.0
13 x 1-7/8"	< 1/4"	13	1.125	72.5	5	1.250	72.5	3	7	11	0	0	48	603.2
	other	13	1.125	84.5	5	1.250	84.5	3	7	13	0	0	56	703.1
13 x 2"	< 1/4"	13	1.250	78.5	5	1.375	78.5	3	7	12	0	0	52	717.2
	other	13	1.250	90.5	5	1.500	90.5	3	7	14	0	0	60	859.0
13 x 2-1/8"	< 1/4"	13	1.250	78.5	5	1.500	78.5	3	7	12	0	0	52	745.0
	other	13	1.250	90.5	5	1.500	90.5	3	7	14	0	0	60	859.0
13 x 2-1/4"	< 1/4"	13	1.375	84.5	5	1.625	84.5	3	7	13	0	0	56	870.9
	other	13	1.375	96.5	5	1.625	96.5	3	7	15	0	0	64	994.6

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Staggered Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
14 x 3/4"	< 1/4"	14	0.500	21.5	5.5	0.625	21.5	2	5	2	1	2.5	24	107.4
	other	14	0.500	33.5	5.5	0.625	33.5	2	5	4	1	2.5	40	169.8
14 x 7/8"	< 1/4"	14	0.500	27.5	5.5	0.750	27.5	2	5	3	1	2.5	32	149.3
	other	14	0.500	39.5	5.5	0.750	39.5	2	5	5	1	2.5	48	216.4
14 x 1"	< 1/4"	14	0.625	27.5	5.5	0.750	27.5	2	5	3	1	2.5	32	163.0
	other	14	0.625	45.5	5.5	0.750	45.5	2	5	6	1	2.5	56	272.5
14 x 1-1/8"	< 1/4"	14	0.750	27.5	5.5	0.750	27.5	2	5	3	1	2.5	32	176.6
	other	14	0.750	39.5	5.5	0.750	39.5	2	5	5	1	2.5	48	255.6
14 x 1-1/4"	< 1/4"	14	0.875	33.5	5.5	0.875	33.5	2	5	4	1	2.5	40	245.8
	other	14	0.875	39.5	5.5	1.000	39.5	2	5	5	1	2.5	48	306.0
14 x 1-3/8"	< 1/4"	14	0.875	33.5	5.5	1.000	33.5	2	5	4	1	2.5	40	258.9
	other	14	0.875	45.5	5.5	1.000	45.5	2	5	6	1	2.5	56	353.2
14 x 1-1/2"	< 1/4"	14	0.875	33.5	5.5	1.125	33.5	2	5	4	1	2.5	40	271.9
	other	14	0.875	45.5	5.5	1.125	45.5	2	5	6	1	2.5	56	370.9
14 x 1-5/8"	< 1/4"	14	1.000	39.5	5.5	1.125	39.5	2	5	5	1	2.5	48	341.0
	other	14	1.000	45.5	5.5	1.125	45.5	2	5	6	1	2.5	56	393.5
14 x 1-3/4"	< 1/4"	14	1.125	39.5	5.5	1.250	39.5	2	5	5	1	2.5	48	376.0
	other	14	1.125	45.5	5.5	1.250	45.5	2	5	6	1	2.5	56	433.8
14 x 1-7/8"	< 1/4"	14	1.250	45.5	5.5	1.250	45.5	2	5	6	1	2.5	56	456.4
	other	14	1.250	51.5	5.5	1.250	51.5	2	5	7	1	2.5	64	517.2
14 x 2"	< 1/4"	14	1.250	45.5	5.5	1.375	45.5	2	5	6	1	2.5	56	474.1
	other	14	1.250	51.5	5.5	1.375	51.5	2	5	7	1	2.5	64	537.2
14 x 2-1/8"	< 1/4"	14	1.375	51.5	5.5	1.375	51.5	2	5	7	1	2.5	64	562.8
	other	14	1.375	57.5	5.5	1.375	57.5	2	5	8	1	2.5	72	628.9
14 x 2-1/4"	< 1/4"	14	1.500	51.5	5.5	1.500	51.5	2	5	7	1	2.5	64	608.4
	other	14	1.500	63.5	5.5	1.500	63.5	2	5	9	1	2.5	80	751.2

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-3

Splice Design

Field Flange Splice Tables (Cont.)

ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Staggered Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
15 x 3/4"	< 1/4"	15	0.500	27.5	6.5	0.500	27.5	2	6	3	1	2.5	32	139.6
	other	15	0.500	39.5	6.5	0.500	39.5	2	6	5	1	2.5	48	202.4
15 x 7/8"	< 1/4"	15	0.500	27.5	6.5	0.625	27.5	2	6	3	1	2.5	32	152.2
	other	15	0.500	39.5	6.5	0.625	39.5	2	6	5	1	2.5	48	220.6
15 x 1"	< 1/4"	15	0.625	33.5	6.5	0.625	33.5	2	6	4	1	2.5	40	204.2
	other	15	0.625	45.5	6.5	0.625	45.5	2	6	6	1	2.5	56	279.0
15 x 1-1/8"	< 1/4"	15	0.625	33.5	6.5	0.750	33.5	2	6	4	1	2.5	40	219.7
	other	15	0.625	51.5	6.5	0.750	51.5	2	6	7	1	2.5	64	340.1
15 x 1-1/4"	< 1/4"	15	0.750	33.5	6.5	0.875	33.5	2	6	4	1	2.5	40	252.9
	other	15	0.750	45.5	6.5	0.875	45.5	2	6	6	1	2.5	56	345.1
15 x 1-3/8"	< 1/4"	15	0.875	33.5	6.5	0.875	33.5	2	6	4	1	2.5	40	270.7
	other	15	0.875	45.5	6.5	0.875	45.5	2	6	6	1	2.5	56	369.3
15 x 1-1/2"	< 1/4"	15	0.875	39.5	6.5	1.000	39.5	2	6	5	1	2.5	48	338.2
	other	15	0.875	45.5	6.5	1.000	45.5	2	6	6	1	2.5	56	390.3
15 x 1-5/8"	< 1/4"	15	1.000	39.5	6.5	1.000	39.5	2	6	5	1	2.5	48	359.2
	other	15	1.000	51.5	6.5	1.000	51.5	2	6	7	1	2.5	64	469.7
15 x 1-3/4"	< 1/4"	15	1.125	45.5	6.5	1.125	45.5	2	6	6	1	2.5	56	459.6
	other	15	1.125	51.5	6.5	1.125	51.5	2	6	7	1	2.5	64	520.8
15 x 1-7/8"	< 1/4"	15	1.125	45.5	6.5	1.250	45.5	2	6	6	1	2.5	56	480.6
	other	15	1.125	51.5	6.5	1.250	51.5	2	6	7	1	2.5	64	544.5
15 x 2"	< 1/4"	15	1.250	51.5	6.5	1.250	51.5	2	6	7	1	2.5	64	571.9
	other	15	1.250	57.5	6.5	1.250	57.5	2	6	8	1	2.5	72	639.1
15 x 2-1/8"	< 1/4"	15	1.250	51.5	6.5	1.375	51.5	2	6	7	1	2.5	64	595.7
	other	15	1.250	57.5	6.5	1.375	57.5	2	6	8	1	2.5	72	665.6
15 x 2-1/4"	< 1/4"	15	1.375	51.5	6.5	1.375	51.5	2	6	7	1	2.5	64	623.0
	other	15	1.375	63.5	6.5	1.375	63.5	2	6	9	1	2.5	80	769.2

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
16 x 3/4"	< 1/4"	16	0.500	24.5	7	0.500	24.5	2	6	3	1	3	32	134.6
	other	16	0.500	36.5	7	0.500	36.5	2	6	5	1	3	48	200.9
16 x 7/8"	< 1/4"	16	0.500	24.5	7	0.500	24.5	2	6	3	1	3	32	134.6
	other	16	0.500	42.5	7	0.500	42.5	2	6	6	1	3	56	234.0
16 x 1"	< 1/4"	16	0.625	30.5	7	0.625	30.5	2	6	4	1	3	40	200.2
	other	16	0.625	42.5	7	0.750	42.5	2	6	6	1	3	56	300.3
16 x 1-1/8"	< 1/4"	16	0.625	30.5	7	0.750	30.5	2	6	4	1	3	40	215.3
	other	16	0.625	48.5	7	0.750	48.5	2	6	7	1	3	64	342.7
16 x 1-1/4"	< 1/4"	16	0.750	30.5	7	0.750	30.5	2	6	4	1	3	40	232.6
	other	16	0.750	42.5	7	0.750	42.5	2	6	6	1	3	56	324.4
16 x 1-3/8"	< 1/4"	16	0.750	30.5	7	0.875	30.5	2	6	4	1	3	40	247.7
	other	16	0.750	42.5	7	0.875	42.5	2	6	6	1	3	56	345.4
16 x 1-1/2"	< 1/4"	16	0.875	36.5	7	0.875	36.5	2	6	5	1	3	48	317.3
	other	16	0.875	48.5	7	0.875	48.5	2	6	7	1	3	64	421.8
16 x 1-5/8"	< 1/4"	16	0.875	36.5	7	1.000	36.5	2	6	5	1	3	48	335.4
	other	16	0.875	48.5	7	1.000	48.5	2	6	7	1	3	64	445.9
16 x 1-3/4"	< 1/4"	16	1.000	36.5	7	1.125	36.5	2	6	5	1	3	48	374.2
	other	16	1.000	48.5	7	1.125	48.5	2	6	7	1	3	64	497.5
16 x 1-7/8"	< 1/4"	16	1.125	42.5	7	1.125	42.5	2	6	6	1	3	56	459.9
	other	16	1.125	54.5	7	1.125	54.5	2	6	8	1	3	72	590.0
16 x 2"	< 1/4"	16	1.125	42.5	7	1.250	42.5	2	6	6	1	3	56	481.0
	other	16	1.125	54.5	7	1.250	54.5	2	6	8	1	3	72	617.0
16 x 2-1/8"	< 1/4"	16	1.250	48.5	7	1.250	48.5	2	6	7	1	3	64	576.5
	other	16	1.250	60.5	7	1.250	60.5	2	6	9	1	3	80	719.3
16 x 2-1/4"	< 1/4"	16	1.250	48.5	7	1.375	48.5	2	6	7	1	3	64	600.6
	other	16	1.250	60.5	7	1.375	60.5	2	6	9	1	3	80	749.4

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-4

Splice Design

Field Flange Splice Tables (Cont.)

ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
17 x 3/4"	< 1/4"	17	0.500	24.5	7	0.500	24.5	2.5	6	3	1	3	32	138.1
	other	17	0.500	36.5	7	0.625	36.5	2.5	6	5	1	3	48	224.1
17 x 7/8"	< 1/4"	17	0.500	24.5	7	0.625	24.5	2.5	6	3	1	3	32	150.2
	other	17	0.500	42.5	7	0.625	42.5	2.5	6	6	1	3	56	261.1
17 x 1"	< 1/4"	17	0.625	30.5	7	0.625	30.5	2.25	6.5	4	1	3	40	205.6
	other	17	0.625	48.5	7	0.625	48.5	2.25	6.5	7	1	3	64	327.3
17 x 1-1/8"	< 1/4"	17	0.625	36.5	7	0.750	36.5	2.25	6.5	5	1	3	48	264.2
	other	17	0.625	48.5	7	0.750	48.5	2.25	6.5	7	1	3	64	351.3
17 x 1-1/4"	< 1/4"	17	0.750	30.5	7	0.875	30.5	2	7	4	1	3	40	254.2
	other	17	0.750	42.5	7	0.875	42.5	2	7	6	1	3	56	354.5
17 x 1-3/8"	< 1/4"	17	0.875	36.5	7	0.875	36.5	2	7	5	1	3	48	326.3
	other	17	0.875	48.5	7	0.875	48.5	2	7	7	1	3	64	433.8
17 x 1-1/2"	< 1/4"	17	0.875	36.5	7	1.000	36.5	2	7	5	1	3	48	344.5
	other	17	0.875	48.5	7	1.000	48.5	2	7	7	1	3	64	457.9
17 x 1-5/8"	< 1/4"	17	1.000	42.5	7	1.000	42.5	2	7	6	1	3	56	426.8
	other	17	1.000	54.5	7	1.000	54.5	2	7	8	1	3	72	547.5
17 x 1-3/4"	< 1/4"	17	1.125	42.5	7	1.125	42.5	2	7	6	1	3	56	473.5
	other	17	1.125	54.5	7	1.125	54.5	2	7	8	1	3	72	607.4
17 x 1-7/8"	< 1/4"	17	1.125	48.5	7	1.125	48.5	2	7	7	1	3	64	540.4
	other	17	1.125	54.5	7	1.125	54.5	2	7	8	1	3	72	607.4
17 x 2"	< 1/4"	17	1.250	48.5	7	1.250	48.5	2	7	7	1	3	64	593.7
	other	17	1.250	60.5	7	1.250	60.5	2	7	9	1	3	80	740.8
17 x 2-1/8"	< 1/4"	17	1.250	48.5	7	1.375	48.5	2	7	7	1	3	64	617.8
	other	17	1.250	60.5	7	1.375	60.5	2	7	9	1	3	80	770.8
17 x 2-1/4"	< 1/4"	17	1.375	54.5	7	1.375	54.5	2	7	8	1	3	72	727.1
	other	17	1.375	66.5	7	1.375	66.5	2	7	10	1	3	88	887.4

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
18 x 3/4"	< 1/4"	18	0.500	24.5	8	0.500	24.5	2	6	3	1	4	32	148.5
	other	18	0.500	42.5	8	0.500	42.5	2	6	6	1	4	56	258.1
18 x 7/8"	< 1/4"	18	0.500	30.5	8	0.500	30.5	2	6	4	1	4	40	185.0
	other	18	0.500	48.5	8	0.500	48.5	2	6	7	1	4	64	294.6
18 x 1"	< 1/4"	18	0.500	36.5	8	0.625	36.5	2	6	5	1	4	48	242.3
	other	18	0.500	48.5	8	0.625	48.5	2	6	7	1	4	64	322.1
18 x 1-1/8"	< 1/4"	18	0.625	36.5	8	0.750	36.5	2.25	6.5	5	1	3.5	48	286.2
	other	18	0.625	54.5	8	0.750	54.5	2.25	6.5	8	1	3.5	72	427.7
18 x 1-1/4"	< 1/4"	18	0.750	36.5	8	0.750	36.5	2.5	7	5	1	3	48	309.5
	other	18	0.750	48.5	8	0.750	48.5	2.5	7	7	1	3	64	411.5
18 x 1-3/8"	< 1/4"	18	0.750	36.5	8	0.875	36.5	2.5	7	5	1	3	48	330.2
	other	18	0.750	48.5	8	0.875	48.5	2.5	7	7	1	3	64	439.0
18 x 1-1/2"	< 1/4"	18	0.875	42.5	8	0.875	42.5	2.5	7	6	1	3	56	411.7
	other	18	0.875	54.5	8	0.875	54.5	2.5	7	8	1	3	72	528.2
18 x 1-5/8"	< 1/4"	18	0.875	42.5	8	1.000	42.5	2.5	7	6	1	3	56	435.8
	other	18	0.875	54.5	8	1.000	54.5	2.5	7	8	1	3	72	559.1
18 x 1-3/4"	< 1/4"	18	1.000	48.5	8	1.000	48.5	2.5	7	7	1	3	64	528.4
	other	18	1.000	54.5	8	1.000	54.5	2.5	7	8	1	3	72	593.8
18 x 1-7/8"	< 1/4"	18	1.000	48.5	8	1.125	48.5	2.5	7	7	1	3	64	555.9
	other	18	1.000	54.5	8	1.125	54.5	2.5	7	8	1	3	72	624.8
18 x 2"	< 1/4"	18	1.125	54.5	8	1.125	54.5	2.5	7	8	1	3	72	659.5
	other	18	1.125	60.5	8	1.125	60.5	2.5	7	9	1	3	80	732.2
18 x 2-1/8"	< 1/4"	18	1.250	54.5	8	1.250	54.5	2.5	7	8	1	3	72	725.2
	other	18	1.250	66.5	8	1.250	66.5	2.5	7	10	1	3	88	885.0
18 x 2-1/4"	< 1/4"	18	1.250	54.5	8	1.375	54.5	2.5	7	8	1	3	72	756.1
	other	18	1.250	66.5	8	1.375	66.5	2.5	7	10	1	3	88	922.7

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-5

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
19 x 7/8"	< 1/4"	19	0.500	30.5	8.5	0.500	30.5	2	6	4	1	4.5	40	193.7
	other	19	0.500	48.5	8.5	0.500	48.5	2	6	7	1	4.5	64	308.4
19 x 1"	< 1/4"	19	0.500	36.5	8.5	0.625	36.5	2	6	5	1	4.5	48	253.9
	other	19	0.500	54.5	8.5	0.625	54.5	2	6	8	1	4.5	72	379.4
19 x 1-1/8"	< 1/4"	19	0.625	36.5	8.5	0.750	36.5	2.25	6.5	5	1	4	48	300.5
	other	19	0.625	54.5	8.5	0.750	54.5	2.25	6.5	8	1	4	72	449.0
19 x 1-1/4"	< 1/4"	19	0.750	36.5	8.5	0.750	36.5	2.5	7	5	1	3.5	48	325.1
	other	19	0.750	48.5	8.5	0.750	48.5	2.5	7	7	1	3.5	64	432.1
19 x 1-3/8"	< 1/4"	19	0.750	36.5	8.5	0.875	36.5	2.5	7	5	1	3.5	48	347.0
	other	19	0.750	48.5	8.5	0.875	48.5	2.5	7	7	1	3.5	64	461.4
19 x 1-1/2"	< 1/4"	19	0.875	42.5	8.5	0.875	42.5	2.5	7	6	1	3.5	56	432.8
	other	19	0.875	54.5	8.5	0.875	54.5	2.5	7	8	1	3.5	72	555.2
19 x 1-5/8"	< 1/4"	19	0.875	42.5	8.5	1.000	42.5	2.5	7	6	1	3.5	56	458.4
	other	19	0.875	54.5	8.5	1.000	54.5	2.5	7	8	1	3.5	72	588.1
19 x 1-3/4"	< 1/4"	19	1.000	48.5	8.5	1.000	48.5	2.5	7	7	1	3.5	64	555.9
	other	19	1.000	60.5	8.5	1.000	60.5	2.5	7	9	1	3.5	80	693.6
19 x 1-7/8"	< 1/4"	19	1.000	48.5	8.5	1.125	48.5	2.5	7	7	1	3.5	64	585.1
	other	19	1.000	60.5	8.5	1.125	60.5	2.5	7	9	1	3.5	80	730.1
19 x 2"	< 1/4"	19	1.125	54.5	8.5	1.125	54.5	2.5	7	8	1	3.5	72	694.3
	other	19	1.125	66.5	8.5	1.125	66.5	2.5	7	10	1	3.5	88	847.3
19 x 2-1/8"	< 1/4"	19	1.125	54.5	8.5	1.250	54.5	2.5	7	8	1	3.5	72	727.1
	other	19	1.125	66.5	8.5	1.250	66.5	2.5	7	10	1	3.5	88	887.4
19 x 2-1/4"	< 1/4"	19	1.250	60.5	8.5	1.250	60.5	2.5	7	9	1	3.5	80	848.0
	other	19	1.250	72.5	8.5	1.250	72.5	2.5	7	11	1	3.5	96	1016.3

bolt threads are Excluded from shear plane

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
20 x 7/8"	< 1/4"	20	0.500	30.5	9	0.500	30.5	2	6	4	1	5	40	202.3
	other	20	0.500	48.5	9	0.500	48.5	2	6	7	1	5	64	322.1
20 x 1"	< 1/4"	20	0.500	36.5	9	0.625	36.5	2	6	5	1	5	48	265.5
	other	20	0.500	54.5	9	0.625	54.5	2	6	8	1	5	72	396.8
20 x 1-1/8"	< 1/4"	20	0.625	42.5	9	0.625	42.5	2.25	6.5	6	1	4.5	56	339.4
	other	20	0.625	60.5	9	0.625	60.5	2.25	6.5	9	1	4.5	80	483.4
20 x 1-1/4"	< 1/4"	20	0.750	36.5	9	0.750	36.5	2.5	7	5	1	4	48	340.6
	other	20	0.750	54.5	9	0.750	54.5	2.5	7	8	1	4	72	508.8
20 x 1-3/8"	< 1/4"	20	0.750	42.5	9	0.875	42.5	2.5	7	6	1	4	56	423.8
	other	20	0.750	54.5	9	0.875	54.5	2.5	7	8	1	4	72	543.6
20 x 1-1/2"	< 1/4"	20	0.875	42.5	9	0.875	42.5	2.5	7	6	1	4	56	453.9
	other	20	0.875	60.5	9	0.875	60.5	2.5	7	9	1	4	80	646.4
20 x 1-5/8"	< 1/4"	20	0.875	48.5	9	1.000	48.5	2.5	7	7	1	4	64	549.0
	other	20	0.875	54.5	9	1.000	54.5	2.5	7	8	1	4	72	617.0
20 x 1-3/4"	< 1/4"	20	1.000	48.5	9	1.000	48.5	2.5	7	7	1	4	64	583.4
	other	20	1.000	60.5	9	1.000	60.5	2.5	7	9	1	4	80	727.9
20 x 1-7/8"	< 1/4"	20	1.000	54.5	9	1.125	54.5	2.5	7	8	1	4	72	690.4
	other	20	1.000	60.5	9	1.125	60.5	2.5	7	9	1	4	80	766.5
20 x 2"	< 1/4"	20	1.125	60.5	9	1.125	60.5	2.5	7	9	1	4	80	809.4
	other	20	1.125	66.5	9	1.125	66.5	2.5	7	10	1	4	88	889.7
20 x 2-1/8"	< 1/4"	20	1.125	60.5	9	1.250	60.5	2.5	7	9	1	4	80	848.0
	other	20	1.125	66.5	9	1.250	66.5	2.5	7	10	1	4	88	932.2
20 x 2-1/4"	< 1/4"	20	1.250	66.5	9	1.250	66.5	2.5	7	10	1	4	88	979.3
	other	20	1.250	78.5	9	1.250	78.5	2.5	7	12	1	4	104	1156.1

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-6

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
21 x 7/8"	< 1/4"	21	0.500	36.5	9.5	0.500	36.5	2	6	5	1	5.5	48	252.6
	other	21	0.500	54.5	9.5	0.500	54.5	2	6	8	1	5.5	72	377.5
21 x 1"	< 1/4"	21	0.625	36.5	9.5	0.625	36.5	2.25	6.5	5	1	5	48	304.4
	other	21	0.500	60.5	9.5	0.625	60.5	2	6	9	1	5.5	80	459.9
21 x 1-1/8"	< 1/4"	21	0.625	42.5	9.5	0.625	42.5	2.25	6.5	6	1	5	56	354.5
	other	21	0.625	60.5	9.5	0.750	60.5	2.25	6.5	9	1	5	80	545.6
21 x 1-1/4"	< 1/4"	21	0.750	42.5	9.5	0.750	42.5	2.5	7	6	1	4.5	56	414.7
	other	21	0.750	54.5	9.5	0.750	54.5	2.5	7	8	1	4.5	72	532.0
21 x 1-3/8"	< 1/4"	21	0.750	42.5	9.5	0.875	42.5	2.5	7	6	1	4.5	56	443.4
	other	21	0.750	54.5	9.5	0.875	54.5	2.5	7	8	1	4.5	72	568.7
21 x 1-1/2"	< 1/4"	21	0.875	48.5	9.5	0.875	48.5	2.5	7	7	1	4.5	64	542.2
	other	21	0.875	60.5	9.5	0.875	60.5	2.5	7	9	1	4.5	80	676.4
21 x 1-5/8"	< 1/4"	21	0.875	48.5	9.5	1.000	48.5	2.5	7	7	1	4.5	64	574.8
	other	21	0.875	60.5	9.5	1.000	60.5	2.5	7	9	1	4.5	80	717.2
21 x 1-3/4"	< 1/4"	21	1.000	54.5	9.5	1.000	54.5	2.5	7	8	1	4.5	72	686.6
	other	21	1.000	66.5	9.5	1.000	66.5	2.5	7	10	1	4.5	88	837.9
21 x 1-7/8"	< 1/4"	21	1.000	54.5	9.5	1.125	54.5	2.5	7	8	1	4.5	72	723.3
	other	21	1.000	66.5	9.5	1.125	66.5	2.5	7	10	1	4.5	88	882.7
21 x 2"	< 1/4"	21	1.125	60.5	9.5	1.125	60.5	2.5	7	9	1	4.5	80	848.0
	other	21	1.125	72.5	9.5	1.125	72.5	2.5	7	11	1	4.5	96	1016.3
21 x 2-1/8"	< 1/4"	21	1.125	60.5	9.5	1.250	60.5	2.5	7	9	1	4.5	80	888.7
	other	21	1.125	72.5	9.5	1.250	72.5	2.5	7	11	1	4.5	96	1065.2
21 x 2-1/4"	< 1/4"	21	1.250	66.5	9.5	1.250	66.5	2.5	7	10	1	4.5	88	1026.5
	other	21	1.250	78.5	9.5	1.250	78.5	2.5	7	12	1	4.5	104	1211.8

bolt threads are **Excluded** from shear plane

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
22 x 1"	< 1/4"	22	0.625	24.5	10	0.625	24.5	2	6	3	2	3	48	228.0
	other	22	0.625	36.5	10	0.625	36.5	2	6	5	2	3	72	340.1
22 x 1-1/8"	< 1/4"	22	0.625	30.5	10	0.750	30.5	2	6	4	2	3	60	305.7
	other	22	0.625	42.5	10	0.750	42.5	2	6	6	2	3	84	426.3
22 x 1-1/4"	< 1/4"	22	0.750	24.5	10	0.750	24.5	2	6	3	2	3	48	264.4
	other	22	0.750	36.5	10	0.750	36.5	2	6	5	2	3	72	394.4
22 x 1-3/8"	< 1/4"	22	0.750	30.5	10	0.875	30.5	2	6	4	2	3	60	351.1
	other	22	0.750	36.5	10	0.875	36.5	2	6	5	2	3	72	420.3
22 x 1-1/2"	< 1/4"	22	0.875	30.5	10	1.000	30.5	2	6	4	2	3	60	396.5
	other	22	0.875	42.5	10	1.000	42.5	2	6	6	2	3	84	552.8
22 x 1-5/8"	< 1/4"	22	0.875	30.5	10	1.000	30.5	2	6	4	2	3	60	396.5
	other	22	0.875	42.5	10	1.000	42.5	2	6	6	2	3	84	552.8
22 x 1-3/4"	< 1/4"	22	1.000	36.5	10	1.125	36.5	2	6	5	2	3	72	529.0
	other	22	1.000	42.5	10	1.125	42.5	2	6	6	2	3	84	616.1
22 x 1-7/8"	< 1/4"	22	1.000	36.5	10	1.125	36.5	2	6	5	2	3	72	529.0
	other	22	1.000	42.5	10	1.125	42.5	2	6	6	2	3	84	616.1
22 x 2"	< 1/4"	22	1.125	42.5	10	1.250	42.5	2	6	6	2	3	84	679.4
	other	22	1.125	48.5	10	1.250	48.5	2	6	7	2	3	96	775.4
22 x 2-1/8"	< 1/4"	22	1.125	42.5	10	1.250	42.5	2	6	6	2	3	84	679.4
	other	22	1.125	48.5	10	1.250	48.5	2	6	7	2	3	96	775.4
22 x 2-1/4"	< 1/4"	22	1.250	42.5	10	1.375	42.5	2	6	6	2	3	84	742.6
	other	22	1.250	54.5	10	1.375	54.5	2	6	8	2	3	108	952.6

bolt threads are **Excluded** from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-7

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 50 and 50W Flanges, Grade 50 and 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
23 x 1"	< 1/4"	23	0.500	30.5	10.5	0.625	30.5	2	6	4	2	3.25	60	270.0
	other	23	0.500	42.5	10.5	0.625	42.5	2	6	6	2	3.25	84	376.6
23 x 1-1/8"	< 1/4"	23	0.625	30.5	10.5	0.750	30.5	2.25	6.5	4	2	3	60	317.5
	other	23	0.625	42.5	10.5	0.750	42.5	2.25	6.5	6	2	3	84	442.9
23 x 1-1/4"	< 1/4"	23	0.750	30.5	10.5	0.750	30.5	2.25	6.5	4	2	3	60	342.4
	other	23	0.750	36.5	10.5	0.750	36.5	2.25	6.5	5	2	3	72	410.0
23 x 1-3/8"	< 1/4"	23	0.750	30.5	10.5	0.875	30.5	2.25	6.5	4	2	3	60	365.1
	other	23	0.750	42.5	10.5	0.875	42.5	2.25	6.5	6	2	3	84	509.1
23 x 1-1/2"	< 1/4"	23	0.875	30.5	10.5	0.875	30.5	2.25	6.5	4	2	3	60	390.0
	other	23	0.875	42.5	10.5	0.875	42.5	2.25	6.5	6	2	3	84	543.8
23 x 1-5/8"	< 1/4"	23	0.875	36.5	10.5	1.000	36.5	2.25	6.5	5	2	3	72	494.0
	other	23	0.875	42.5	10.5	1.000	42.5	2.25	6.5	6	2	3	84	575.4
23 x 1-3/4"	< 1/4"	23	1.000	36.5	10.5	1.125	36.5	2.25	6.5	5	2	3	72	551.0
	other	23	1.000	42.5	10.5	1.125	42.5	2.25	6.5	6	2	3	84	641.7
23 x 1-7/8"	< 1/4"	23	1.000	36.5	10.5	1.125	36.5	2.25	6.5	5	2	3	72	551.0
	other	23	1.000	48.5	10.5	1.125	48.5	2.25	6.5	7	2	3	96	732.4
23 x 2"	< 1/4"	23	1.125	42.5	10.5	1.250	42.5	2.25	6.5	6	2	3	84	708.0
	other	23	1.125	48.5	10.5	1.250	48.5	2.25	6.5	7	2	3	96	808.1
23 x 2-1/8"	< 1/4"	23	1.125	42.5	10.5	1.250	42.5	2.25	6.5	6	2	3	84	708.0
	other	23	1.125	54.5	10.5	1.250	54.5	2.25	6.5	8	2	3	108	908.2
23 x 2-1/4"	< 1/4"	23	1.250	48.5	10.5	1.375	48.5	2.25	6.5	7	2	3	96	883.7
	other	23	1.250	54.5	10.5	1.375	54.5	2.25	6.5	8	2	3	108	993.2

bolt threads are **Excluded** from shear plane

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
24 x 1"	< 1/4"	24	0.500	30.5	11	0.625	30.5	2	6	4	2	3.5	60	279.7
	other	24	0.625	42.5	11	0.625	42.5	2.25	6.5	6	2	3.25	84	426.3
24 x 1-1/8"	< 1/4"	24	0.625	30.5	11	0.750	30.5	2.25	6.5	4	2	3.25	60	329.4
	other	24	0.625	48.5	11	0.750	48.5	2.25	6.5	7	2	3.25	96	524.4
24 x 1-1/4"	< 1/4"	24	0.750	30.5	11	0.750	30.5	2.5	7	4	2	3	60	355.4
	other	24	0.750	42.5	11	0.750	42.5	2.5	7	6	2	3	84	495.6
24 x 1-3/8"	< 1/4"	24	0.750	30.5	11	0.875	30.5	2.5	7	4	2	3	60	379.2
	other	24	0.750	42.5	11	0.875	42.5	2.5	7	6	2	3	84	528.7
24 x 1-1/2"	< 1/4"	24	0.875	36.5	11	0.875	36.5	2.5	7	5	2	3	72	485.0
	other	24	0.875	42.5	11	0.875	42.5	2.5	7	6	2	3	84	564.9
24 x 1-5/8"	< 1/4"	24	0.875	36.5	11	1.000	36.5	2.5	7	5	2	3	72	513.5
	other	24	0.875	42.5	11	1.000	42.5	2.5	7	6	2	3	84	598.0
24 x 1-3/4"	< 1/4"	24	1.000	36.5	11	1.125	36.5	2.5	7	5	2	3	72	573.0
	other	24	1.000	48.5	11	1.125	48.5	2.5	7	7	2	3	96	761.7
24 x 1-7/8"	< 1/4"	24	1.000	42.5	11	1.125	42.5	2.5	7	6	2	3	84	667.3
	other	24	1.000	48.5	11	1.125	48.5	2.5	7	7	2	3	96	761.7
24 x 2"	< 1/4"	24	1.125	42.5	11	1.250	42.5	2.5	7	6	2	3	84	736.6
	other	24	1.125	54.5	11	1.250	54.5	2.5	7	8	2	3	108	944.9
24 x 2-1/8"	< 1/4"	24	1.125	48.5	11	1.250	48.5	2.5	7	7	2	3	96	840.7
	other	24	1.125	54.5	11	1.250	54.5	2.5	7	8	2	3	108	944.9
24 x 2-1/4"	< 1/4"	24	1.250	48.5	11	1.375	48.5	2.5	7	7	2	3	96	919.8
	other	24	1.250	60.5	11	1.375	60.5	2.5	7	9	2	3	120	1147.6

bolt threads are **Excluded** from shear plane

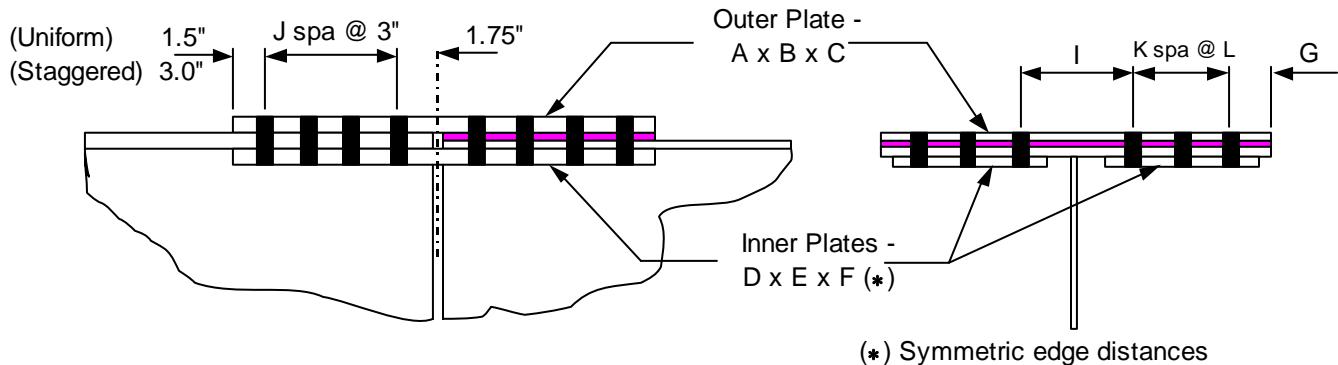
LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-8

Splice Design

FLANGE PLATE SIZE: 12" thru 24" (2-6 rows of Bolts) ASTM A709, Grade 70W Flange, Grade 50W Splice



Note: For staggered bolt patterns the spacing shown above is for the edge rows of bolts.

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
12 x 3/4"	< 1/4"	12"	0.750"	42.5"	5"	0.750"	42.5"	2.5	7	6	0	0	28	225.4
	other	12"	0.750"	72.5"	5"	0.750"	72.5"	2.5	7	9	0	0	40	377.2
12 x 7/8"	< 1/4"	12"	0.750"	42.5"	5"	0.750"	42.5"	2.5	7	6	0	0	28	225.4
	other	12"	0.750"	66.5"	5"	0.875"	66.5"	2.5	7	10	0	0	44	376.5
12 x 1"	< 1/4"	12"	0.875"	48.5"	5"	0.875"	48.5"	2.5	7	7	0	0	32	295.1
	other	12"	0.875"	72.5"	5"	1.000"	72.5"	2.5	7	11	0	0	48	467.0
12 x 1-1/8"	< 1/4"	12"	0.875"	54.5"	5"	1.000"	54.5"	2.5	7	8	0	0	36	351.0
	other	12"	0.875"	78.5"	5"	1.000"	78.5"	2.5	7	12	0	0	52	505.7
12 x 1-1/4"	< 1/4"	12"	1.000"	54.5"	5"	1.125"	54.5"	2.5	7	8	0	0	36	393.5
	other	12"	1.000"	78.5"	5"	1.125"	78.5"	2.5	7	12	0	0	52	566.9
12 x 1-3/8"	< 1/4"	12"	1.125"	60.5"	5"	1.250"	60.5"	2.5	7	9	0	0	40	484.0
	other	12"	1.125"	84.5"	5"	1.250"	84.5"	2.5	7	13	0	0	56	676.2
12 x 1-1/2"	< 1/4"	12"	1.250"	66.5"	5"	1.375"	66.5"	2.5	7	10	0	0	44	583.9
	other	12"	1.250"	90.5"	5"	1.375"	90.5"	2.5	7	14	0	0	60	794.8
12 x 1-5/8"	< 1/4"	12"	1.375"	72.5"	5"	1.500"	72.5"	2.5	7	11	0	0	48	693.2
	other	12"	1.375"	90.5"	5"	1.500"	90.5"	2.5	7	14	0	0	60	865.4
12 x 1-3/4"	< 1/4"	12"	1.375"	78.5"	5"	1.625"	78.5"	2.5	7	12	0	0	52	778.4
	other	12"	1.375"	96.5"	5"	1.625"	96.5"	2.5	7	15	0	0	64	957.0
12 x 1-7/8"	< 1/4"	12"	1.500"	84.5"	5"	1.750"	84.5"	2.5	7	13	0	0	56	903.8
	other	12"	1.500"	96.5"	5"	1.750"	96.5"	2.5	7	15	0	0	64	1032.2
12 x 2"	< 1/4"	12"	1.500"	90.5"	5"	1.750"	90.5"	2.5	7	14	0	0	60	968.0
	other	12"	1.500"	96.5"	5"	1.750"	96.5"	2.5	7	15	0	0	64	1032.2
12 x 2-1/8"	< 1/4"	12"	1.625"	96.5"	5"	1.875"	96.5"	2.5	7	15	0	0	64	1107.5
12 x 2-1/4"	< 1/4"	12"	1.750"	102.5"	5"	1.875"	102.5"	2.5	7	16	0	0	68	1219.9

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-9

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
13 x 3/4"	< 1/4"	13"	0.625"	48.5"	4.5"	0.875"	48.5"	3.25	6.5	7	0	0	32	250.4
	other	13"	0.625"	78.5"	4.5"	0.875"	78.5"	3.25	6.5	12	0	0	52	405.6
13 x 7/8"	< 1/4"	13"	0.750"	48.5"	5"	0.750"	48.5"	3	7	7	0	0	32	267.6
	other	13"	0.750"	72.5"	5"	0.875"	72.5"	3	7	11	0	0	48	425.9
13 x 1"	< 1/4"	13"	0.875"	54.5"	5"	0.875"	54.5"	3	7	8	0	0	36	345.2
	other	13"	0.750"	78.5"	5"	1.000"	78.5"	3	7	12	0	0	52	489.0
13 x 1-1/8"	< 1/4"	13"	0.875"	54.5"	5"	1.125"	54.5"	3	7	8	0	0	36	383.9
	other	13"	0.875"	84.5"	5"	1.125"	84.5"	3	7	13	0	0	56	595.3
13 x 1-1/4"	< 1/4"	13"	1.000"	60.5"	5"	1.250"	60.5"	3	7	9	0	0	40	475.5
	other	13"	1.000"	90.5"	5"	1.250"	90.5"	3	7	14	0	0	60	711.4
13 x 1-3/8"	< 1/4"	13"	1.125"	66.5"	5"	1.375"	66.5"	3	7	10	0	0	44	576.9
	other	13"	1.125"	90.5"	5"	1.375"	90.5"	3	7	14	0	0	60	785.2
13 x 1-1/2"	< 1/4"	13"	1.250"	72.5"	5"	1.500"	72.5"	3	7	11	0	0	48	688.1
	other	13"	1.250"	96.5"	5"	1.500"	96.5"	3	7	15	0	0	64	915.9
13 x 1-5/8"	< 1/4"	13"	1.375"	78.5"	5"	1.625"	78.5"	3	7	12	0	0	52	809.0
	other	13"	1.375"	102.5"	5"	1.625"	102.5"	3	7	16	0	0	68	1056.5
13 x 1-3/4"	< 1/4"	13"	1.500"	90.5"	5"	1.625"	90.5"	3	7	14	0	0	60	974.4
	other	13"	1.500"	102.5"	5"	1.875"	102.5"	3	7	16	0	0	68	1176.4
13 x 1-7/8"	< 1/4"	13"	1.500"	96.5"	5"	1.625"	96.5"	3	7	15	0	0	64	1039.1
	other	13"	1.500"	102.5"	5"	1.875"	102.5"	3	7	16	0	0	68	1176.4
13 x 2"	< 1/4"	13"	1.625"	102.5"	5"	1.750"	102.5"	3	7	16	0	0	68	1187.3
	other	13"	1.625"	144.5"	5"	1.750"	144.5"	3	7	23	0	0	96	1673.9
13 x 2-1/8"	< 1/4"	13"	1.750"	102.5"	5"	2.125"	102.5"	3	7	16	0	0	68	1343.5
13 x 2-1/4"	< 1/4"	13"	1.750"	144.5"	5"	2.000"	144.5"	3	7	23	0	0	96	1842.9

bolt threads are Excluded from shear plane

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Staggered Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
14 x 3/4"	< 1/4"	14"	0.625"	27.5"	5.5"	0.750"	27.5"	2	5	3	1	2.5	32	163.0
	other	14"	0.625"	45.5"	5.5"	0.750"	45.5"	2	5	6	1	2.5	56	272.5
14 x 7/8"	< 1/4"	14"	0.750"	33.5"	5.5"	0.875"	33.5"	2	5	4	1	2.5	40	229.2
	other	14"	0.750"	39.5"	5.5"	0.875"	39.5"	2	5	5	1	2.5	48	271.0
14 x 1"	< 1/4"	14"	0.875"	33.5"	5.5"	0.875"	33.5"	2	5	4	1	2.5	40	245.8
	other	14"	0.875"	45.5"	5.5"	1.000"	45.5"	2	5	6	1	2.5	56	353.2
14 x 1-1/8"	< 1/4"	14"	1.000"	39.5"	5.5"	1.000"	39.5"	2	5	5	1	2.5	48	325.6
	other	14"	1.000"	51.5"	5.5"	1.000"	51.5"	2	5	7	1	2.5	64	425.9
14 x 1-1/4"	< 1/4"	14"	1.000"	39.5"	5.5"	1.125"	39.5"	2	5	5	1	2.5	48	341.0
	other	14"	1.000"	51.5"	5.5"	1.125"	51.5"	2	5	7	1	2.5	64	446.0
14 x 1-3/8"	< 1/4"	14"	1.125"	39.5"	5.5"	1.250"	39.5"	2	5	5	1	2.5	48	376.0
	other	14"	1.125"	57.5"	5.5"	1.250"	57.5"	2	5	8	1	2.5	72	549.4
14 x 1-1/2"	< 1/4"	14"	1.250"	45.5"	5.5"	1.375"	45.5"	2	5	6	1	2.5	56	474.1
	other	14"	1.250"	57.5"	5.5"	1.375"	57.5"	2	5	8	1	2.5	72	600.3
14 x 1-5/8"	< 1/4"	14"	1.375"	51.5"	5.5"	1.375"	51.5"	2	5	7	1	2.5	64	562.8
	other	14"	1.375"	63.5"	5.5"	1.375"	63.5"	2	5	9	1	2.5	80	695.0
14 x 1-3/4"	< 1/4"	14"	1.500"	51.5"	5.5"	1.500"	51.5"	2	5	7	1	2.5	64	608.4
	other	14"	1.500"	63.5"	5.5"	1.500"	63.5"	2	5	9	1	2.5	80	751.2
14 x 1-7/8"	< 1/4"	14"	1.625"	57.5"	5.5"	1.625"	57.5"	2	5	8	1	2.5	72	730.8
	other	14"	1.500"	63.5"	5.5"	1.750"	63.5"	2	5	9	1	2.5	80	800.8
14 x 2"	< 1/4"	14"	1.625"	57.5"	5.5"	1.750"	57.5"	2	5	8	1	2.5	72	753.2
	other	14"	1.625"	63.5"	5.5"	1.750"	63.5"	2	5	9	1	2.5	80	832.3
14 x 2-1/8"	< 1/4"	14"	1.750"	63.5"	5.5"	1.875"	63.5"	2	5	9	1	2.5	80	888.5
14 x 2-1/4"	< 1/4"	14"	1.875"	69.5"	5.5"	1.875"	69.5"	2	5	10	1	2.5	88	1007.4

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-10

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Staggered Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
15 x 3/4"	< 1/4"	15"	0.625"	33.5"	6.5"	0.625"	33.5"	2	6	4	1	2.5	40	204.2
	other	15"	0.625"	51.5"	6.5"	0.625"	51.5"	2	6	7	1	2.5	64	316.4
15 x 7/8"	< 1/4"	15"	0.625"	33.5"	6.5"	0.750"	33.5"	2	6	4	1	2.5	40	219.7
	other	15"	0.625"	51.5"	6.5"	0.750"	51.5"	2	6	7	1	2.5	64	340.1
15 x 1"	< 1/4"	15"	0.750"	33.5"	6.5"	0.875"	33.5"	2	6	4	1	2.5	40	252.9
	other	15"	0.750"	45.5"	6.5"	0.875"	45.5"	2	6	6	1	2.5	56	345.1
15 x 1-1/8"	< 1/4"	15"	0.875"	39.5"	6.5"	1.000"	39.5"	2	6	5	1	2.5	48	338.2
	other	15"	0.875"	51.5"	6.5"	1.000"	51.5"	2	6	7	1	2.5	64	442.3
15 x 1-1/4"	< 1/4"	15"	1.000"	39.5"	6.5"	1.000"	39.5"	2	6	5	1	2.5	48	359.2
	other	15"	1.000"	57.5"	6.5"	1.000"	57.5"	2	6	8	1	2.5	72	524.9
15 x 1-3/8"	< 1/4"	15"	1.125"	45.5"	6.5"	1.125"	45.5"	2	6	6	1	2.5	56	459.6
	other	15"	1.125"	57.5"	6.5"	1.125"	57.5"	2	6	8	1	2.5	72	582.0
15 x 1-1/2"	< 1/4"	15"	1.250"	51.5"	6.5"	1.250"	51.5"	2	6	7	1	2.5	64	571.9
	other	15"	1.250"	63.5"	6.5"	1.250"	63.5"	2	6	9	1	2.5	80	706.2
15 x 1-5/8"	< 1/4"	15"	1.250"	51.5"	6.5"	1.375"	51.5"	2	6	7	1	2.5	64	595.7
	other	15"	1.250"	63.5"	6.5"	1.375"	63.5"	2	6	9	1	2.5	80	735.5
15 x 1-3/4"	< 1/4"	15"	1.375"	57.5"	6.5"	1.375"	57.5"	2	6	8	1	2.5	72	696.1
	other	15"	1.375"	63.5"	6.5"	1.375"	63.5"	2	6	9	1	2.5	80	769.2
15 x 1-7/8"	< 1/4"	15"	1.500"	57.5"	6.5"	1.500"	57.5"	2	6	8	1	2.5	72	753.2
	other	15"	1.500"	69.5"	6.5"	1.500"	69.5"	2	6	10	1	2.5	88	911.3
15 x 2"	< 1/4"	15"	1.625"	63.5"	6.5"	1.625"	63.5"	2	6	9	1	2.5	80	895.3
	other	15"	1.625"	69.5"	6.5"	1.625"	69.5"	2	6	10	1	2.5	88	980.3
15 x 2-1/8"	< 1/4"	15"	1.625"	63.5"	6.5"	1.750"	63.5"	2	6	9	1	2.5	80	924.5
15 x 2-1/4"	< 1/4"	15"	1.750"	69.5"	6.5"	1.750"	69.5"	2	6	10	1	2.5	88	1049.3

bolt threads are Excluded from shear plane

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
16 x 3/4"	< 1/4"	16"	0.625"	30.5"	7"	0.625"	30.5"	2	6	4	1	3	40	200.2
	other	16"	0.625"	48.5"	7"	0.625"	48.5"	2	6	7	1	3	64	318.7
16 x 7/8"	< 1/4"	16"	0.625"	36.5"	7"	0.750"	36.5"	2	6	5	1	3	48	257.8
	other	16"	0.625"	54.5"	7"	0.750"	54.5"	2	6	8	1	3	72	385.2
16 x 1"	< 1/4"	16"	0.750"	30.5"	7"	0.875"	30.5"	2	6	4	1	3	40	247.7
	other	16"	0.750"	48.5"	7"	0.875"	48.5"	2	6	7	1	3	64	394.3
16 x 1-1/8"	< 1/4"	16"	0.875"	36.5"	7"	0.875"	36.5"	2	6	5	1	3	48	317.3
	other	16"	0.875"	54.5"	7"	0.875"	54.5"	2	6	8	1	3	72	474.1
16 x 1-1/4"	< 1/4"	16"	1.000"	42.5"	7"	1.000"	42.5"	2	6	6	1	3	56	414.7
	other	16"	1.000"	54.5"	7"	1.000"	54.5"	2	6	8	1	3	72	532.0
16 x 1-3/8"	< 1/4"	16"	1.000"	42.5"	7"	1.125"	42.5"	2	6	6	1	3	56	435.8
	other	16"	1.000"	54.5"	7"	1.125"	54.5"	2	6	8	1	3	72	559.1
16 x 1-1/2"	< 1/4"	16"	1.125"	42.5"	7"	1.250"	42.5"	2	6	6	1	3	56	481.0
	other	16"	1.125"	60.5"	7"	1.250"	60.5"	2	6	9	1	3	80	685.0
16 x 1-5/8"	< 1/4"	16"	1.250"	48.5"	7"	1.250"	48.5"	2	6	7	1	3	64	576.5
	other	16"	1.250"	66.5"	7"	1.250"	66.5"	2	6	10	1	3	88	790.7
16 x 1-3/4"	< 1/4"	16"	1.375"	54.5"	7"	1.375"	54.5"	2	6	8	1	3	72	705.9
	other	16"	1.375"	66.5"	7"	1.375"	66.5"	2	6	10	1	3	88	861.5
16 x 1-7/8"	< 1/4"	16"	1.500"	60.5"	7"	1.500"	60.5"	2	6	9	1	3	80	848.0
	other	16"	1.500"	66.5"	7"	1.500"	66.5"	2	6	10	1	3	88	932.2
16 x 2"	< 1/4"	16"	1.500"	60.5"	7"	1.500"	60.5"	2	6	9	1	3	80	848.0
	other	16"	1.500"	66.5"	7"	1.500"	66.5"	2	6	10	1	3	88	932.2
16 x 2-1/8"	< 1/4"	16"	1.625"	66.5"	7"	1.625"	66.5"	2	6	10	1	3	88	1002.9
16 x 2-1/4"	< 1/4"	16"	1.625"	66.5"	7"	1.750"	66.5"	2	6	10	1	3	88	1035.9

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-11

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
17 x 3/4"	< 1/4"	17"	0.625"	30.5"	7"	0.750"	30.5"	2.25	6.5	4	1	3	40	220.7
	other	17"	0.625"	48.5"	7"	0.750"	48.5"	2.25	6.5	7	1	3	64	351.3
17 x 7/8"	< 1/4"	17"	0.750"	30.5"	7"	0.750"	30.5"	2	7	4	1	3	40	239.1
	other	17"	0.750"	48.5"	7"	0.750"	48.5"	2	7	7	1	3	64	380.6
17 x 1"	< 1/4"	17"	0.875"	36.5"	7"	0.875"	36.5"	2	7	5	1	3	48	326.3
	other	17"	0.875"	48.5"	7"	1.000"	48.5"	2	7	7	1	3	64	457.9
17 x 1-1/8"	< 1/4"	17"	0.875"	36.5"	7"	1.000"	36.5"	2	7	5	1	3	48	344.5
	other	17"	0.875"	54.5"	7"	1.000"	54.5"	2	7	8	1	3	72	514.6
17 x 1-1/4"	< 1/4"	17"	1.000"	42.5"	7"	1.000"	42.5"	2	7	6	1	3	56	426.8
	other	17"	1.000"	54.5"	7"	1.125"	54.5"	2	7	8	1	3	72	574.5
17 x 1-3/8"	< 1/4"	17"	1.000"	42.5"	7"	1.250"	42.5"	2	7	6	1	3	56	469.0
	other	17"	1.000"	60.5"	7"	1.250"	60.5"	2	7	9	1	3	80	667.9
17 x 1-1/2"	< 1/4"	17"	1.125"	48.5"	7"	1.375"	48.5"	2	7	7	1	3	64	588.6
	other	17"	1.125"	60.5"	7"	1.375"	60.5"	2	7	9	1	3	80	734.3
17 x 1-5/8"	< 1/4"	17"	1.250"	54.5"	7"	1.375"	54.5"	2	7	8	1	3	72	694.3
	other	17"	1.250"	66.5"	7"	1.375"	66.5"	2	7	10	1	3	88	847.3
17 x 1-3/4"	< 1/4"	17"	1.375"	60.5"	7"	1.375"	60.5"	2	7	9	1	3	80	807.3
	other	17"	1.375"	72.5"	7"	1.375"	72.5"	2	7	11	1	3	96	967.5
17 x 1-7/8"	< 1/4"	17"	1.500"	66.5"	7"	1.500"	66.5"	2	7	10	1	3	88	960.5
	other	17"	1.500"	72.5"	7"	1.500"	72.5"	2	7	11	1	3	96	1047.2
17 x 2"	< 1/4"	17"	1.500"	66.5"	7"	1.625"	66.5"	2	7	10	1	3	88	993.5
	other	17"	1.500"	72.5"	7"	1.625"	72.5"	2	7	11	1	3	96	1083.1
17 x 2-1/8"	< 1/4"	17"	1.625"	66.5"	7"	1.750"	66.5"	2	7	10	1	3	88	1066.5
17 x 2-1/4"	< 1/4"	17"	1.750"	72.5"	7"	1.750"	72.5"	2	7	11	1	3	96	1206.5

bolt threads are Excluded from shear plane

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
18 x 3/4"	< 1/4"	18"	0.625"	36.5"	8"	0.625"	36.5"	2.25	6.5	5	1	3.5	48	265.5
	other	18"	0.625"	54.5"	8"	0.625"	54.5"	2.25	6.5	8	1	3.5	72	396.8
18 x 7/8"	< 1/4"	18"	0.750"	30.5"	8"	0.750"	30.5"	2.5	7	4	1	3	40	258.5
	other	18"	0.750"	48.5"	8"	0.750"	48.5"	2.5	7	7	1	3	64	411.5
18 x 1"	< 1/4"	18"	0.750"	36.5"	8"	0.875"	36.5"	2.5	7	5	1	3	48	330.2
	other	18"	0.750"	54.5"	8"	0.875"	54.5"	2.5	7	8	1	3	72	493.4
18 x 1-1/8"	< 1/4"	18"	0.875"	42.5"	8"	0.875"	42.5"	2.5	7	6	1	3	56	411.7
	other	18"	0.875"	60.5"	8"	0.875"	60.5"	2.5	7	9	1	3	80	586.4
18 x 1-1/4"	< 1/4"	18"	1.000"	42.5"	8"	1.000"	42.5"	2.5	7	6	1	3	56	463.0
	other	18"	1.000"	60.5"	8"	1.125"	60.5"	2.5	7	9	1	3	80	693.6
18 x 1-3/8"	< 1/4"	18"	1.000"	48.5"	8"	1.125"	48.5"	2.5	7	7	1	3	64	555.9
	other	18"	1.000"	66.5"	8"	1.125"	66.5"	2.5	7	10	1	3	88	762.5
18 x 1-1/2"	< 1/4"	18"	1.125"	48.5"	8"	1.250"	48.5"	2.5	7	7	1	3	64	614.4
	other	18"	1.125"	66.5"	8"	1.250"	66.5"	2.5	7	10	1	3	88	842.6
18 x 1-5/8"	< 1/4"	18"	1.250"	54.5"	8"	1.250"	54.5"	2.5	7	8	1	3	72	725.2
	other	18"	1.250"	72.5"	8"	1.250"	72.5"	2.5	7	11	1	3	96	964.9
18 x 1-3/4"	< 1/4"	18"	1.375"	60.5"	8"	1.375"	60.5"	2.5	7	9	1	3	80	878.0
	other	18"	1.375"	72.5"	8"	1.375"	72.5"	2.5	7	11	1	3	96	1052.3
18 x 1-7/8"	< 1/4"	18"	1.375"	60.5"	8"	1.500"	60.5"	2.5	7	9	1	3	80	912.3
	other	18"	1.375"	72.5"	8"	1.500"	72.5"	2.5	7	11	1	3	96	1093.4
18 x 2"	< 1/4"	18"	1.500"	66.5"	8"	1.625"	66.5"	2.5	7	10	1	3	88	1083.0
	other	18"	1.500"	72.5"	8"	1.625"	72.5"	2.5	7	11	1	3	96	1180.8
18 x 2-1/8"	< 1/4"	18"	1.625"	72.5"	8"	1.625"	72.5"	2.5	7	11	1	3	96	1227.1
18 x 2-1/4"	< 1/4"	18"	1.750"	78.5"	8"	1.750"	78.5"	2.5	7	12	1	3	104	1423.3

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-12

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
19 x 7/8"	< 1/4"	19"	0.750"	36.5"	8.5"	0.750"	36.5"	2.5	7	5	1	3.5	48	325.1
	other	19"	0.750"	54.5"	8.5"	0.750"	54.5"	2.5	7	8	1	3.5	72	485.7
19 x 1"	< 1/4"	19"	0.750"	36.5"	8.5"	0.875"	36.5"	2.5	7	5	1	3.5	48	347.0
	other	19"	0.750"	54.5"	8.5"	0.875"	54.5"	2.5	7	8	1	3.5	72	518.5
19 x 1-1/8"	< 1/4"	19"	0.875"	42.5"	8.5"	0.875"	42.5"	2.5	7	6	1	3.5	56	432.8
	other	19"	0.875"	60.5"	8.5"	0.875"	60.5"	2.5	7	9	1	3.5	80	616.4
19 x 1-1/4"	< 1/4"	19"	1.000"	48.5"	8.5"	1.000"	48.5"	2.5	7	7	1	3.5	64	555.9
	other	19"	1.000"	66.5"	8.5"	1.000"	66.5"	2.5	7	10	1	3.5	88	762.5
19 x 1-3/8"	< 1/4"	19"	1.000"	48.5"	8.5"	1.125"	48.5"	2.5	7	7	1	3.5	64	585.1
	other	19"	1.000"	66.5"	8.5"	1.125"	66.5"	2.5	7	10	1	3.5	88	802.5
19 x 1-1/2"	< 1/4"	19"	1.125"	54.5"	8.5"	1.250"	54.5"	2.5	7	8	1	3.5	72	727.1
	other	19"	1.125"	72.5"	8.5"	1.250"	72.5"	2.5	7	11	1	3.5	96	967.5
19 x 1-5/8"	< 1/4"	19"	1.250"	60.5"	8.5"	1.250"	60.5"	2.5	7	9	1	3.5	80	848.0
	other	19"	1.250"	78.5"	8.5"	1.250"	78.5"	2.5	7	12	1	3.5	104	1100.5
19 x 1-3/4"	< 1/4"	19"	1.375"	66.5"	8.5"	1.375"	66.5"	2.5	7	10	1	3.5	88	1017.0
	other	19"	1.375"	78.5"	8.5"	1.375"	78.5"	2.5	7	12	1	3.5	104	1200.7
19 x 1-7/8"	< 1/4"	19"	1.375"	66.5"	8.5"	1.500"	66.5"	2.5	7	10	1	3.5	88	1057.1
	other	19"	1.375"	78.5"	8.5"	1.500"	78.5"	2.5	7	12	1	3.5	104	1248.0
19 x 2"	< 1/4"	19"	1.500"	66.5"	8.5"	1.625"	66.5"	2.5	7	10	1	3.5	88	1142.0
	other	19"	1.500"	78.5"	8.5"	1.625"	78.5"	2.5	7	12	1	3.5	104	1348.1
19 x 2-1/8"	< 1/4"	19"	1.625"	78.5"	8.5"	1.625"	78.5"	2.5	7	12	1	3.5	104	1401.0
19 x 2-1/4"	< 1/4"	19"	1.750"	84.5"	8.5"	1.750"	84.5"	2.5	7	13	1	3.5	112	1616.0
Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
20 x 7/8"	< 1/4"	20"	0.750"	36.5"	9"	0.750"	36.5"	2.5	7	5	1	4	48	340.6
	other	20"	0.750"	54.5"	9"	0.750"	54.5"	2.5	7	8	1	4	72	508.8
20 x 1"	< 1/4"	20"	0.750"	36.5"	9"	0.875"	36.5"	2.5	7	5	1	4	48	363.9
	other	20"	0.750"	60.5"	9"	0.875"	60.5"	2.5	7	9	1	4	80	603.5
20 x 1-1/8"	< 1/4"	20"	0.875"	42.5"	9"	0.875"	42.5"	2.5	7	6	1	4	56	453.9
	other	20"	0.875"	66.5"	9"	0.875"	66.5"	2.5	7	10	1	4	88	710.6
20 x 1-1/4"	< 1/4"	20"	1.000"	48.5"	9"	1.000"	48.5"	2.5	7	7	1	4	64	583.4
	other	20"	1.000"	72.5"	9"	1.000"	72.5"	2.5	7	11	1	4	96	872.4
20 x 1-3/8"	< 1/4"	20"	1.000"	54.5"	9"	1.125"	54.5"	2.5	7	8	1	4	72	690.4
	other	20"	1.000"	72.5"	9"	1.125"	72.5"	2.5	7	11	1	4	96	918.7
20 x 1-1/2"	< 1/4"	20"	1.125"	54.5"	9"	1.250"	54.5"	2.5	7	8	1	4	72	763.8
	other	20"	1.125"	72.5"	9"	1.250"	72.5"	2.5	7	11	1	4	96	1016.3
20 x 1-5/8"	< 1/4"	20"	1.250"	60.5"	9"	1.250"	60.5"	2.5	7	9	1	4	80	890.9
	other	20"	1.250"	78.5"	9"	1.250"	78.5"	2.5	7	12	1	4	104	1156.1
20 x 1-3/4"	< 1/4"	20"	1.375"	66.5"	9"	1.375"	66.5"	2.5	7	10	1	4	88	1068.9
	other	20"	1.375"	84.5"	9"	1.375"	84.5"	2.5	7	13	1	4	112	1358.4
20 x 1-7/8"	< 1/4"	20"	1.375"	66.5"	9"	1.500"	66.5"	2.5	7	10	1	4	88	1111.3
	other	20"	1.375"	78.5"	9"	1.500"	78.5"	2.5	7	12	1	4	104	1312.0
20 x 2"	< 1/4"	20"	1.500"	72.5"	9"	1.625"	72.5"	2.5	7	11	1	4	96	1309.3
	other	20"	1.500"	78.5"	9"	1.625"	78.5"	2.5	7	12	1	4	104	1417.7
20 x 2-1/8"	< 1/4"	20"	1.625"	78.5"	9"	1.625"	78.5"	2.5	7	12	1	4	104	1473.3
20 x 2-1/4"	< 1/4"	20"	1.750"	84.5"	9"	1.750"	84.5"	2.5	7	13	1	4	112	1699.8

bolt threads are Excluded from shear plane

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-13

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
21 x 7/8"	< 1/4"	21"	0.750"	36.5"	9.5"	0.750"	36.5"	2.5	7	5	1	4.5	48	356.1
	other	21"	0.750"	60.5"	9.5"	0.750"	60.5"	2.5	7	9	1	4.5	80	590.7
21 x 1"	< 1/4"	21"	0.750"	42.5"	9.5"	0.875"	42.5"	2.5	7	6	1	4.5	56	443.4
	other	21"	0.750"	60.5"	9.5"	0.875"	60.5"	2.5	7	9	1	4.5	80	631.4
21 x 1-1/8"	< 1/4"	21"	0.875"	48.5"	9.5"	0.875"	48.5"	2.5	7	7	1	4.5	64	542.2
	other	21"	0.875"	66.5"	9.5"	0.875"	66.5"	2.5	7	10	1	4.5	88	743.6
21 x 1-1/4"	< 1/4"	21"	1.000"	54.5"	9.5"	1.000"	54.5"	2.5	7	8	1	4.5	72	686.6
	other	21"	1.000"	72.5"	9.5"	1.000"	72.5"	2.5	7	11	1	4.5	96	913.5
21 x 1-3/8"	< 1/4"	21"	1.000"	54.5"	9.5"	1.125"	54.5"	2.5	7	8	1	4.5	72	723.3
	other	21"	1.000"	72.5"	9.5"	1.125"	72.5"	2.5	7	11	1	4.5	96	962.4
21 x 1-1/2"	< 1/4"	21"	1.125"	60.5"	9.5"	1.250"	60.5"	2.5	7	9	1	4.5	80	888.7
	other	21"	1.125"	78.5"	9.5"	1.250"	78.5"	2.5	7	12	1	4.5	104	1153.4
21 x 1-5/8"	< 1/4"	21"	1.250"	66.5"	9.5"	1.250"	66.5"	2.5	7	10	1	4.5	88	1026.5
	other	21"	1.250"	84.5"	9.5"	1.250"	84.5"	2.5	7	13	1	4.5	112	1304.5
21 x 1-3/4"	< 1/4"	21"	1.375"	72.5"	9.5"	1.375"	72.5"	2.5	7	11	1	4.5	96	1221.9
	other	21"	1.375"	84.5"	9.5"	1.375"	84.5"	2.5	7	13	1	4.5	112	1424.3
21 x 1-7/8"	< 1/4"	21"	1.375"	72.5"	9.5"	1.500"	72.5"	2.5	7	11	1	4.5	96	1270.7
	other	21"	1.375"	84.5"	9.5"	1.500"	84.5"	2.5	7	13	1	4.5	112	1481.2
21 x 2"	< 1/4"	21"	1.500"	78.5"	9.5"	1.625"	78.5"	2.5	7	12	1	4.5	104	1487.3
	other	21"	1.500"	84.5"	9.5"	1.625"	84.5"	2.5	7	13	1	4.5	112	1601.0
21 x 2-1/8"	< 1/4"	21"	1.625"	84.5"	9.5"	1.625"	84.5"	2.5	7	13	1	4.5	112	1663.9
21 x 2-1/4"	< 1/4"	21"	1.750"	90.5"	9.5"	1.750"	90.5"	2.5	7	14	1	4.5	120	1910.4

Flange	Filler Plate Thick. (in)	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
22 x 1"	< 1/4"	22"	0.750"	30.5"	10"	0.875"	30.5"	2	6	4	2	3	60	351.1
	other	22"	0.750"	42.5"	10"	0.875"	42.5"	2	6	6	2	3	84	489.6
22 x 1-1/8"	< 1/4"	22"	0.875"	30.5"	10"	0.875"	30.5"	2	6	4	2	3	60	374.8
	other	22"	0.875"	48.5"	10"	0.875"	48.5"	2	6	7	2	3	96	596.6
22 x 1-1/4"	< 1/4"	22"	1.000"	36.5"	10"	1.000"	36.5"	2	6	5	2	3	72	503.1
	other	22"	1.000"	48.5"	10"	1.000"	48.5"	2	6	7	2	3	96	668.8
22 x 1-3/8"	< 1/4"	22"	1.000"	36.5"	10"	1.125"	36.5"	2	6	5	2	3	72	529.0
	other	22"	1.000"	48.5"	10"	1.125"	48.5"	2	6	7	2	3	96	703.2
22 x 1-1/2"	< 1/4"	22"	1.125"	42.5"	10"	1.250"	42.5"	2	6	6	2	3	84	679.4
	other	22"	1.125"	54.5"	10"	1.250"	54.5"	2	6	8	2	3	108	871.5
22 x 1-5/8"	< 1/4"	22"	1.250"	42.5"	10"	1.250"	42.5"	2	6	6	2	3	84	712.5
	other	22"	1.250"	54.5"	10"	1.250"	54.5"	2	6	8	2	3	108	913.9
22 x 1-3/4"	< 1/4"	22"	1.250"	48.5"	10"	1.375"	48.5"	2	6	7	2	3	96	847.6
	other	22"	1.250"	54.5"	10"	1.375"	54.5"	2	6	8	2	3	108	952.6
22 x 1-7/8"	< 1/4"	22"	1.375"	48.5"	10"	1.500"	48.5"	2	6	7	2	3	96	919.8
	other	22"	1.375"	60.5"	10"	1.500"	60.5"	2	6	9	2	3	120	1147.6
22 x 2"	< 1/4"	22"	1.500"	54.5"	10"	1.625"	54.5"	2	6	8	2	3	108	1114.9
	other	22"	1.500"	60.5"	10"	1.625"	60.5"	2	6	9	2	3	120	1237.7
22 x 2-1/8"	< 1/4"	22"	1.500"	54.5"	10"	1.625"	54.5"	2	6	8	2	3	108	1114.9
22 x 2-1/4"	< 1/4"	22"	1.625"	60.5"	10"	1.750"	60.5"	2	6	9	2	3	120	1327.8

bolt threads are Excluded from shear plane

bolt threads are Excluded from shear plane

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.2-14

Splice Design

Field Flange Splice Tables (Cont.) ASTM A709, Grade 70W Flanges, Grade 50W Splices

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
23 x 1"	< 1/4"	23"	0.750"	30.5"	10.5"	0.875"	30.5"	2.25	6.5	4	2	3	60	365.1
	other	23"	0.750"	42.5"	10.5"	0.875"	42.5"	2.25	6.5	6	2	3	84	509.1
23 x 1-1/8"	< 1/4"	23"	0.875"	30.5"	10.5"	0.875"	30.5"	2.25	6.5	4	2	3	60	390.0
	other	23"	0.875"	48.5"	10.5"	0.875"	48.5"	2.25	6.5	7	2	3	96	620.7
23 x 1-1/4"	< 1/4"	23"	1.000"	36.5"	10.5"	1.000"	36.5"	2.25	6.5	5	2	3	72	523.8
	other	23"	1.000"	48.5"	10.5"	1.000"	48.5"	2.25	6.5	7	2	3	96	696.3
23 x 1-3/8"	< 1/4"	23"	1.000"	42.5"	10.5"	1.125"	42.5"	2.25	6.5	6	2	3	84	641.7
	other	23"	1.000"	54.5"	10.5"	1.125"	54.5"	2.25	6.5	8	2	3	108	823.2
23 x 1-1/2"	< 1/4"	23"	1.125"	42.5"	10.5"	1.250"	42.5"	2.25	6.5	6	2	3	84	708.0
	other	23"	1.125"	54.5"	10.5"	1.250"	54.5"	2.25	6.5	8	2	3	108	908.2
23 x 1-5/8"	< 1/4"	23"	1.250"	48.5"	10.5"	1.250"	48.5"	2.25	6.5	7	2	3	96	847.6
	other	23"	1.250"	60.5"	10.5"	1.250"	60.5"	2.25	6.5	9	2	3	120	1057.6
23 x 1-3/4"	< 1/4"	23"	1.250"	48.5"	10.5"	1.375"	48.5"	2.25	6.5	7	2	3	96	883.7
	other	23"	1.250"	60.5"	10.5"	1.375"	60.5"	2.25	6.5	9	2	3	120	1102.6
23 x 1-7/8"	< 1/4"	23"	1.375"	54.5"	10.5"	1.500"	54.5"	2.25	6.5	8	2	3	108	1078.2
	other	23"	1.375"	60.5"	10.5"	1.500"	60.5"	2.25	6.5	9	2	3	120	1197.0
23 x 2"	< 1/4"	23"	1.500"	54.5"	10.5"	1.625"	54.5"	2.25	6.5	8	2	3	108	1163.2
	other	23"	1.500"	60.5"	10.5"	1.625"	60.5"	2.25	6.5	9	2	3	120	1291.3
23 x 2-1/8"	< 1/4"	23"	1.500"	60.5"	10.5"	1.625"	60.5"	2.25	6.5	9	2	3	120	1291.3
23 x 2-1/4"	< 1/4"	23"	1.625"	60.5"	10.5"	1.750"	60.5"	2.25	6.5	9	2	3	120	1385.7

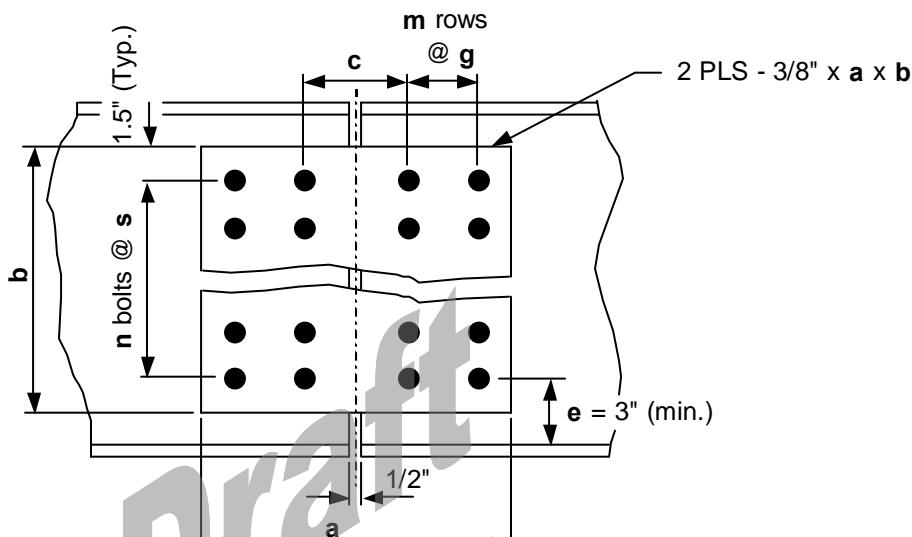
bolt threads are Excluded from shear plane

Flange	Filler Plate Thick.	Outer Plate			Inner Plates			Uniform Bolt Pattern						WT./FLG with 7/8" Bolts (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	K	L (in)	Total # of Bolts	
24 x 1"	< 1/4"	24"	0.750"	30.5"	11"	0.875"	30.5"	2.5	7	4	2	3	60	379.2
	other	24"	0.750"	48.5"	11"	0.875"	48.5"	2.5	7	7	2	3	96	603.5
24 x 1-1/8"	< 1/4"	24"	0.875"	36.5"	11"	0.875"	36.5"	2.5	7	5	2	3	72	485.0
	other	24"	0.875"	48.5"	11"	0.875"	48.5"	2.5	7	7	2	3	96	644.8
24 x 1-1/4"	< 1/4"	24"	1.000"	36.5"	11"	1.000"	36.5"	2.5	7	5	2	3	72	544.5
	other	24"	1.000"	54.5"	11"	1.000"	54.5"	2.5	7	8	2	3	108	813.5
24 x 1-3/8"	< 1/4"	24"	1.000"	42.5"	11"	1.125"	42.5"	2.5	7	6	2	3	84	667.3
	other	24"	1.000"	54.5"	11"	1.125"	54.5"	2.5	7	8	2	3	108	856.0
24 x 1-1/2"	< 1/4"	24"	1.125"	42.5"	11"	1.250"	42.5"	2.5	7	6	2	3	84	736.6
	other	24"	1.125"	60.5"	11"	1.250"	60.5"	2.5	7	9	2	3	120	1049.0
24 x 1-5/8"	< 1/4"	24"	1.250"	48.5"	11"	1.250"	48.5"	2.5	7	7	2	3	96	882.0
	other	24"	1.250"	60.5"	11"	1.250"	60.5"	2.5	7	9	2	3	120	1100.5
24 x 1-3/4"	< 1/4"	24"	1.250"	48.5"	11"	1.375"	48.5"	2.5	7	7	2	3	96	919.8
	other	24"	1.250"	60.5"	11"	1.375"	60.5"	2.5	7	9	2	3	120	1147.6
24 x 1-7/8"	< 1/4"	24"	1.375"	54.5"	11"	1.500"	54.5"	2.5	7	8	2	3	108	1122.6
	other	24"	1.375"	60.5"	11"	1.500"	60.5"	2.5	7	9	2	3	120	1246.3
24 x 2"	< 1/4"	24"	1.500"	60.5"	11"	1.625"	60.5"	2.5	7	9	2	3	120	1344.9
	other	24"	1.500"	66.5"	11"	1.625"	66.5"	2.5	7	10	2	3	132	1478.4
24 x 2-1/8"	< 1/4"	24"	1.500"	60.5"	11"	1.625"	60.5"	2.5	7	9	2	3	120	1344.9
24 x 2-1/4"	< 1/4"	24"	1.625"	66.5"	11"	1.750"	66.5"	2.5	7	10	2	3	132	1586.8

bolt threads are Excluded from shear plane

3.3 Plate Girder - Web Splice Tables

WEB PLATE DEPTH: 36" thru 96" (4 or 6 rows of Bolts)
ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices



Note: Provide shim plates when connecting webs that differ in thickness by 1/8" or more.

Use an equal number of shim plates on each side of the web. Uniformity of web plate thicknesses, which would eliminate the need for the minimum thickness of shim plate, should also be considered.

Web Dimensions		Splice Plates		Bolts							WT./Splice with 7/8" Bolts (lb)
Web Depth (in)	Web Thickness (in)	Plate Width <i>a</i>	Plate Depth <i>b</i>	# rows (<i>m</i>)	# bolts per row (<i>n</i>)	pitch (<i>s</i>)	gage (<i>g</i>)	center (<i>c</i>)	clearance (<i>e</i>)		
36	3/8	14"	31"	2	9	3.5"	3"	5"	4"	126.5	
	7/16	13.5"	33"	2	11	3"	3"	4.5"	3"	136.5	
38	3/8	14"	35"	2	9	4"	3"	5"	3"	138.4	
	7/16	14"	34.5"	2	10	3.5"	3"	5"	3.25"	140.7	
40	3/8	14"	35"	2	9	4"	3"	5"	4"	138.4	
	7/16	13.5"	36"	2	12	3"	3"	4.5"	3.5"	149.0	
	1/2	19.5"	35"	3	9	4"	3"	4.5"	4"	196.4	
42	3/8	13.5"	38"	2	11	3.5"	3"	4.5"	3.5"	150.9	
	7/16	13.5"	38"	2	11	3.5"	3"	4.5"	3.5"	150.9	
	1/2	13.5"	39"	2	13	3"	3"	4.5"	3"	161.4	

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.3-2

Splice Design

Field Web Splices (Cont.)

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices

Web Dimensions		Splice Plates		# rows (m)	# bolts per row (n)	Bolts				WT./Splice with 7/8" Bolts (lb)
Web Depth (in)	Web Thickness (in)	Plate Width a	Plate Depth b			pitch (s)	gage (g)	center (c)	clearance (e)	
44	3/8	14"	39"	2	9	4.5"	3"	5"	4"	150.3
	7/16	14"	38"	2	11	3.5"	3"	5"	4.5"	154.9
	1/2	13.5"	39"	2	13	3"	3"	4.5"	4"	161.4
46	3/8	14"	43"	2	9	5"	3"	5"	3"	162.2
	7/16	13.5"	43"	2	11	4"	3"	4.5"	3"	165.3
	1/2	13.5"	42"	2	14	3"	3"	4.5"	3.5"	173.8
	9/16	19"	43"	3	11	4"	3"	4"	3"	236.5
48	3/8	14"	43"	2	9	5"	3"	5"	4"	162.2
	7/16	14"	43"	2	11	4"	3"	5"	4"	169.8
	1/2	13.5"	45"	2	13	3.5"	3"	4.5"	3"	178.6
	9/16	19"	43"	3	11	4"	3"	4"	4"	236.5
50	3/8	14"	43.5"	2	10	4.5"	3"	5"	4.75"	167.5
	7/16	13.5"	47"	2	12	4"	3"	4.5"	3"	180.5
	1/2	13.5"	45"	2	15	3"	3"	4.5"	4"	186.2
	9/16	19"	47"	3	12	4"	3"	4"	3"	258.3
52	3/8	14"	48"	2	10	5"	3"	5"	3.5"	180.9
	7/16	14"	48"	2	11	4.5"	3"	5"	3.5"	184.7
	1/2	13.5"	48.5"	2	14	3.5"	3"	4.5"	3.25"	192.4
	9/16	13"	48"	2	16	3"	3"	4"	3.5"	193.5
	5/8	19"	48.5"	3	14	3.5"	3"	4"	3.25"	275.8
54	7/16	13.5"	51"	2	13	4"	3"	4.5"	3"	195.8
	1/2	13.5"	51"	2	13	4"	3"	4.5"	3"	195.8
	9/16	13"	51"	2	17	3"	3"	4"	3"	205.6
	5/8	19"	51"	3	13	4"	3"	4"	3"	280.2
56	7/16	14"	53"	2	11	5"	3"	5"	3"	199.6
	1/2	13.5"	52"	2	15	3.5"	3"	4.5"	3.5"	206.3
	9/16	13"	51"	2	17	3"	3"	4"	4"	205.6
	5/8	19"	52"	3	15	3.5"	3"	4"	3.5"	295.6
58	7/16	14"	52.5"	2	12	4.5"	3"	5"	4.25"	201.9
	1/2	13.5"	52"	2	15	3.5"	3"	4.5"	4.5"	206.3
	9/16	13"	54"	2	18	3"	3"	4"	3.5"	217.7
	5/8	19"	55"	3	14	4"	3"	4"	3"	302.0
60	7/16	13.5"	57"	2	13	4.5"	3"	4.5"	3"	213.1
	1/2	13.5"	55.5"	2	16	3.5"	3"	4.5"	3.75"	220.1
	9/16	13"	54"	2	18	3"	3"	4"	4.5"	217.7
	5/8	19"	57"	3	13	4.5"	3"	4"	3"	304.4
62	7/16	14"	57"	2	13	4.5"	3"	5"	4"	219.1
	1/2	13.5"	59"	2	15	4"	3"	4.5"	3"	226.4
	9/16	13"	59"	2	17	3.5"	3"	4"	3"	227.7
	5/8	19"	59"	3	15	4"	3"	4"	3"	323.9
	11/16	19"	59"	3	17	3.5"	3"	4"	3"	335.3
64	7/16	13.5"	59"	2	15	4"	3"	4.5"	4"	226.4
	1/2	13.5"	59"	2	17	3.5"	3"	4.5"	4"	234.0
	9/16	13"	57"	2	19	3"	3"	4"	5"	229.8
	5/8	19"	59"	3	15	4"	3"	4"	4"	323.9
	11/16	19"	59"	3	17	3.5"	3"	4"	4"	335.3

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 3.3-3

Splice Design

Field Web Splices (Cont.)

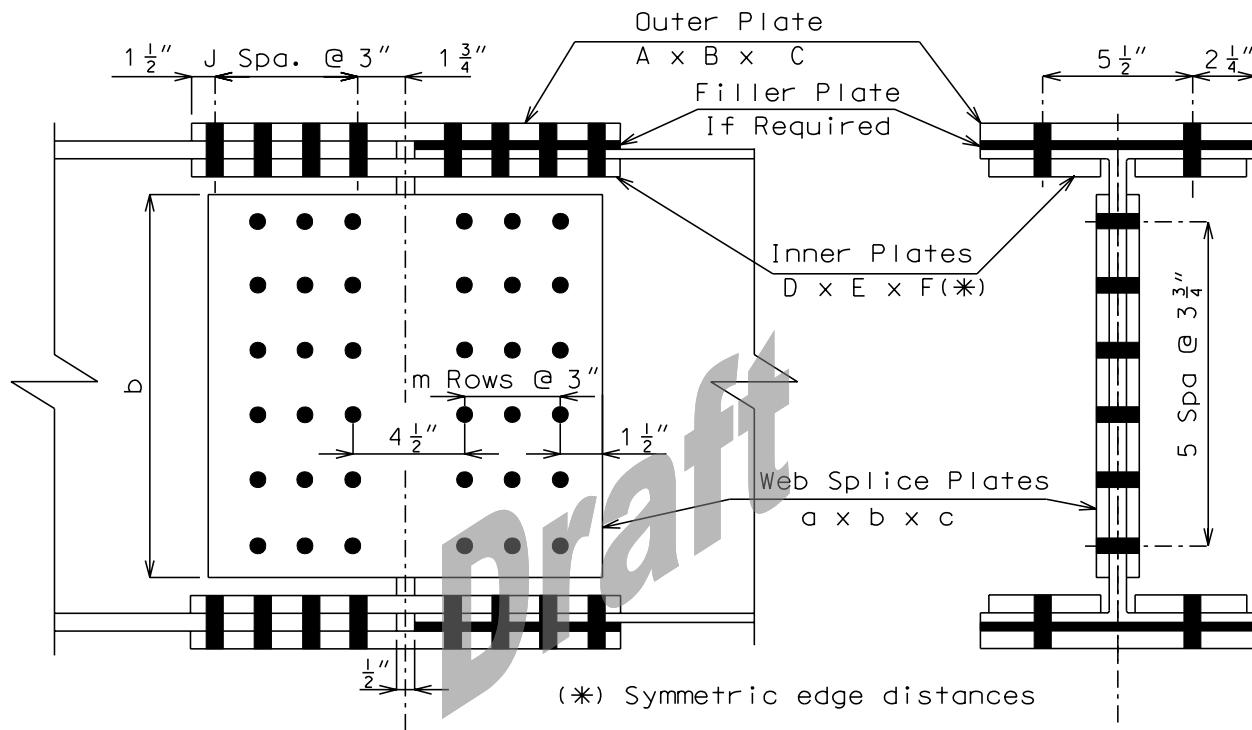
ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices

Web Depth (in)	Web Thickness (in)	Splice Plates		# rows (m)	# bolts per row (n)	Bolts Spacing				WT./Splice with 7/8" Bolts (lb)
		Plate Width a	Plate Depth b			pitch (s)	gage (g)	center (c)	clearance (e)	
66	1/2	13.5"	63"	2	16	4"	3"	4.5"	3"	241.7
	9/16	13"	62.5"	2	18	3.5"	3"	4"	3.25"	241.2
	5/8	13"	63"	2	21	3"	3"	4"	3"	254.0
	11/16	19"	63"	3	16	4"	3"	4"	3"	345.8
68	1/2	13.5"	63"	2	16	4"	3"	4.5"	4"	241.7
	9/16	13"	63"	2	21	3"	3"	4"	4"	254.0
	5/8	19"	63"	3	16	4"	3"	4"	4"	345.8
	11/16	19"	62.5"	3	18	3.5"	3"	4"	4.25"	355.1
70	1/2	13.5"	67"	2	17	4"	3"	4.5"	3"	257.0
	9/16	13"	66"	2	19	3.5"	3"	4"	3.5"	254.7
	5/8	13"	66"	2	22	3"	3"	4"	3.5"	266.1
	11/16	19"	67"	3	17	4"	3"	4"	3"	367.6
72	1/2	13.5"	67"	2	17	4"	3"	4.5"	4"	257.0
	9/16	13"	66"	2	22	3"	3"	4"	4.5"	266.1
	5/8	13"	69"	2	23	3"	3"	4"	3"	278.2
	11/16	19"	67"	3	17	4"	3"	4"	4"	367.6
74	1/2	13.5"	71"	2	18	4"	3"	4.5"	3"	272.2
	9/16	13"	69.5"	2	20	3.5"	3"	4"	3.75"	268.2
	5/8	13"	69"	2	23	3"	3"	4"	4"	278.2
	11/16	19"	71"	3	18	4"	3"	4"	3"	389.5
76	9/16	13"	73"	2	21	3.5"	3"	4"	3"	281.6
	5/8	13"	72"	2	24	3"	3"	4"	3.5"	290.3
	11/16	19"	71"	3	18	4"	3"	4"	4"	389.5
	9/16	13"	73"	2	21	3.5"	3"	4"	4"	281.6
78	5/8	13"	72"	2	24	3"	3"	4"	4.5"	290.3
	11/16	19"	75"	3	17	4.5"	3"	4"	3"	400.0
	9/16	13"	76.5"	2	22	3.5"	3"	4"	3.25"	295.1
80	5/8	13"	75"	2	25	3"	3"	4"	4"	302.4
	11/16	19"	75"	3	19	4"	3"	4"	4"	411.4
	9/16	13"	76.5"	2	22	3.5"	3"	4"	4.25"	295.1
82	5/8	13"	75"	2	25	3"	3"	4"	5"	302.4
	11/16	19"	79"	3	20	4"	3"	4"	3"	433.2
	9/16	13"	80"	2	23	3.5"	3"	4"	3.5"	308.6
84	5/8	13"	78"	2	26	3"	3"	4"	4.5"	314.5
	11/16	13"	81"	2	27	3"	3"	4"	3"	326.5
	5/8	13"	81"	2	27	3"	3"	4"	4"	326.5
86	11/16	19"	79"	3	20	4"	3"	4"	5"	433.2
	5/8	13"	81"	2	27	3"	3"	4"	5"	326.5
88	11/16	13"	84"	2	28	3"	3"	4"	3.5"	338.6
	5/8	13"	81"	2	27	3"	3"	4"	5"	326.5
90	5/8	13"	87"	2	25	3.5"	3"	4"	3"	335.5
	11/16	13"	87"	2	29	3"	3"	4"	3"	350.7
92	5/8	13"	84"	2	28	3"	3"	4"	5.5"	338.6
	11/16	19"	88.5"	3	20	4.5"	3"	4"	3.25"	471.6
94	5/8	13"	90.5"	2	26	3.5"	3"	4"	3.25"	349.0
	11/16	13"	90"	2	30	3"	3"	4"	3.5"	362.8
96	5/8	13"	90"	2	30	3"	3"	4"	4.5"	362.8
	11/16	13"	93"	2	31	3.5"	3"	4"	3"	374.9

3.4 Wide Flange Splice Tables

27" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices



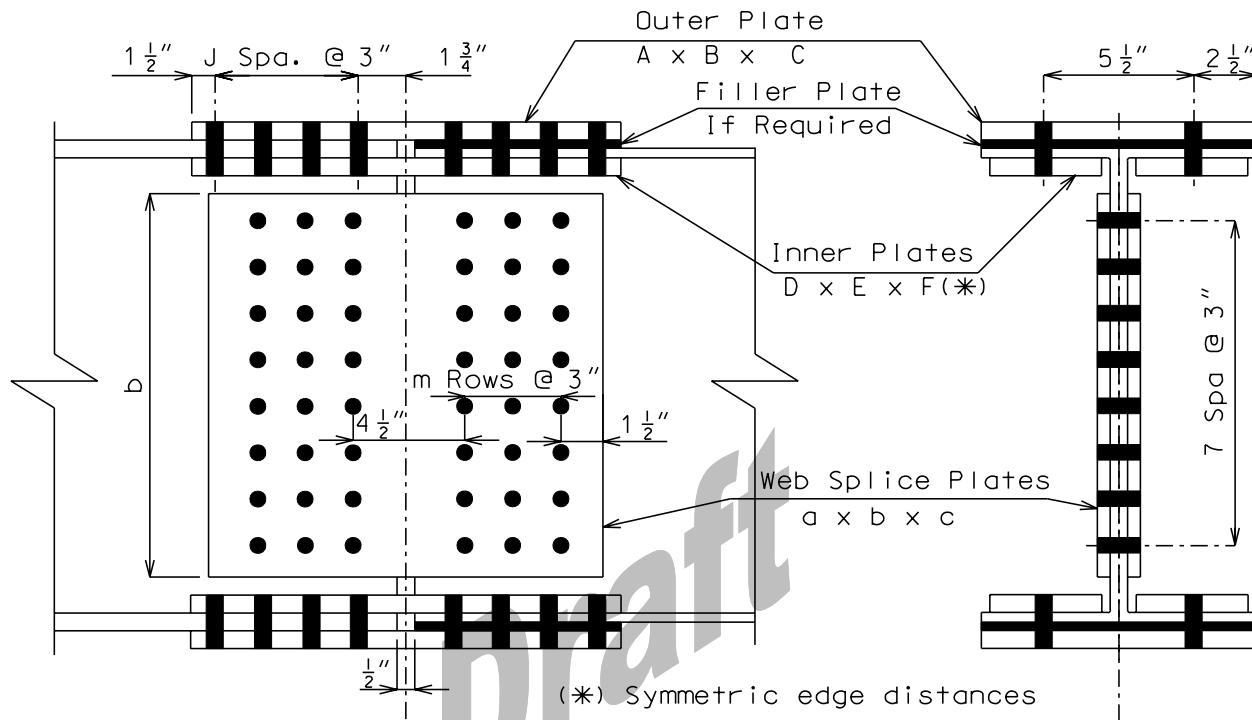
Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details.

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates				Web Splice Plates				Total # of Bolts	Weight (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	J	a (in)	b (in)	c (in)	m		
W27x84**	< 1/4"	10	0.375	18.5	3.5	0.5	18.5	2	19.5	21.75	0.4375	3	48	226.9
	other	10	0.375	24.5	3.5	0.5	24.5	3	19.5	21.75	0.4375	3	52	255.4
W27x94**	< 1/4"	10	0.5	24.5	3.5	0.625	24.5	3	25.5	21.75	0.5	4	64	348.3
	other	10	0.5	30.5	3.5	0.625	30.5	4	25.5	21.75	0.5	4	68	384.0
W27x102**	< 1/4"	10	0.5	24.5	3.5	0.625	24.5	3	25.5	21.75	0.5625	4	64	368.0
	other	Design by Hand												
W27x114**	< 1/4"	10	0.5	24.5	3.5	0.75	24.5	3	25.5	21.75	0.5625	4	64	380.2
	other	Design by Hand												
W27x129**	< 1/4"	10	0.5625	30.5	3.5	0.875	30.5	3	31.5	21.75	0.6875	5	76	542.6
	other	Design by Hand												

**Denotes flange widths less than 12" where P/S Panel placement should be thoroughly investigated.

30" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices



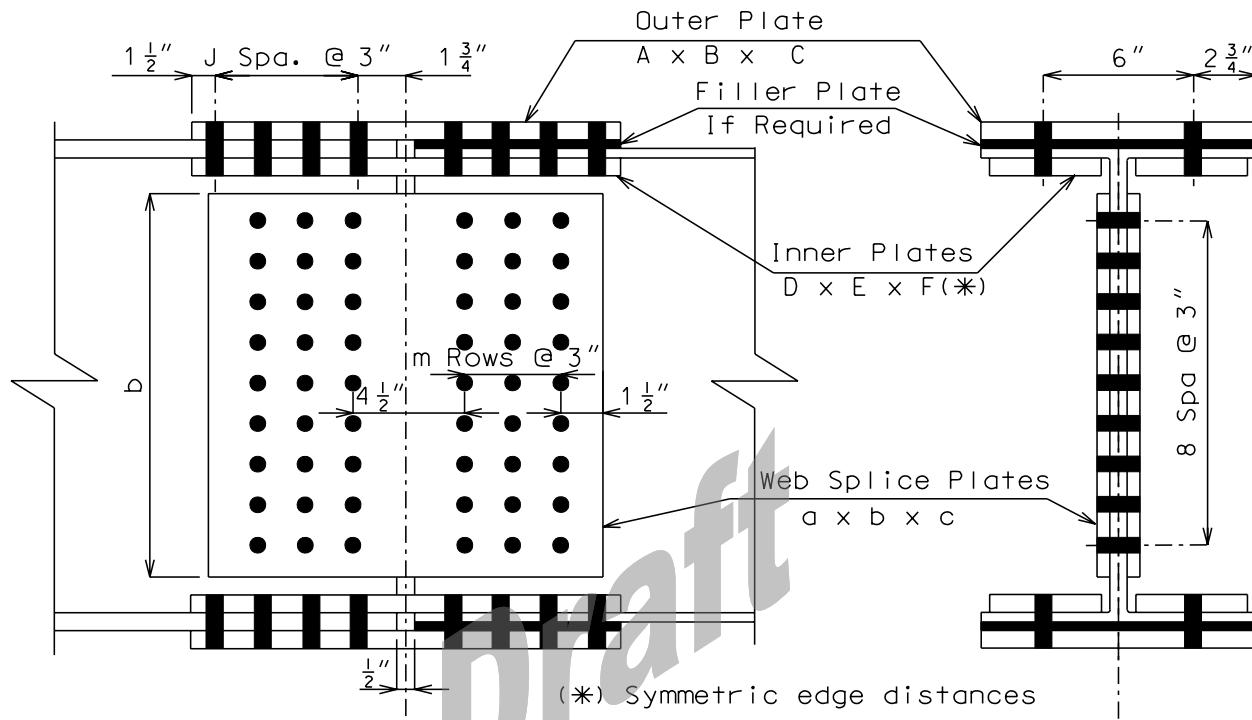
Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details.

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates			Web Splice Plates				Total # of Bolts	Weight (lb)	
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	J	a (in)	b (in)	c (in)	m		
W30x90**	< 1/4"	10.5	0.375	18.5	3.5	0.5	18.5	2	19.5	24	0.4375	3	60	251.2
	other	10.5	0.375	30.5	3.5	0.5	30.5	4	19.5	24	0.4375	3	68	309.4
W30x99**	< 1/4"	10.5	0.375	24.5	3.5	0.5	24.5	3	19.5	24	0.5	3	64	296.8
	other	10.5	0.375	30.5	3.5	0.5	30.5	4	19.5	24	0.5	3	68	326.0
W30x108**	< 1/4"	10.5	0.5	24.5	3.5	0.625	24.5	3	19.5	24	0.5	3	64	327.2
	other	10.5	0.5	36.5	3.5	0.625	36.5	5	19.5	24	0.5	3	72	400.3
W30x116**	< 1/4"	10.5	0.5	30.5	3.5	0.75	30.5	4	25.5	24	0.5625	4	84	456.7
	other	10.5	0.5	30.5	3.5	0.75	30.5	4	25.5	24	0.5625	4	84	456.7
W30x124**	< 1/4"	10.5	0.5	30.5	3.5	0.75	30.5	4	25.5	24	0.5625	4	84	456.7
	other	10.5	0.5	30.5	3.5	0.75	30.5	4	25.5	24	0.5625	4	84	456.7
W30x132**	< 1/4"	10.5	0.5	30.5	3.5	0.75	30.5	4	25.5	24	0.625	4	84	478.4
	other	----- Design by Hand -----												
W30x148**	< 1/4"	10.5	0.625	36.5	3.5	0.875	36.5	5	25.5	24	0.625	4	88	563.2
	other	----- Design by Hand -----												

**Denotes flange widths less than 12" where P/S Panel placement should be thoroughly investigated.

33" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices



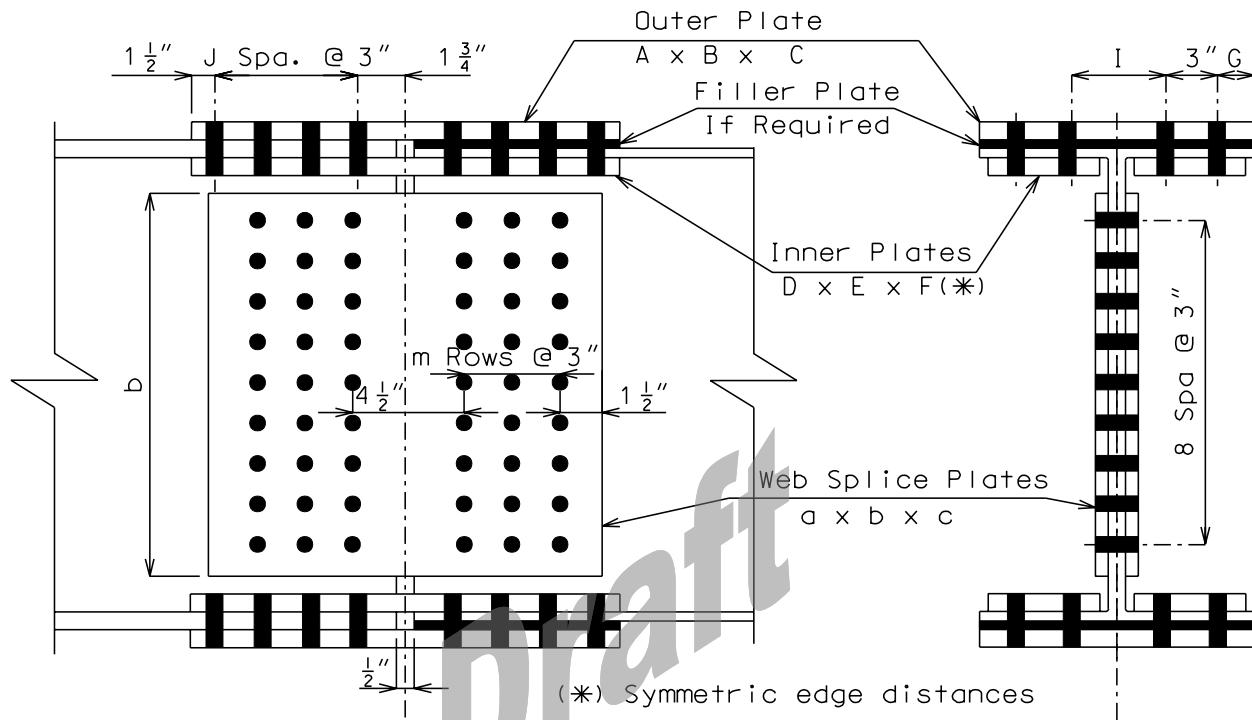
Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details.

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates			Web Splice Plates					Total # of Bolts	Weight (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	J	a (in)	b (in)	c (in)	m		
W33x118**	< 1/4"	11.5	0.5	30.5	3.5	0.625	30.5	4	19.5	27	0.5	3	74	394.7
	other	11.5	0.5	36.5	3.5	0.625	36.5	5	19.5	27	0.5	3	78	433.0
W33x130**	< 1/4"	11.5	0.5	30.5	3.5	0.75	30.5	4	25.5	27	0.5625	4	92	497.3
	other	11.5	0.5	42.5	3.5	0.75	42.5	6	25.5	27	0.5625	4	100	579.8
W33x141**	< 1/4"	11.5	0.625	36.5	3.5	0.875	36.5	5	25.5	27	0.5625	4	96	586.4
	other	11.5	0.625	42.5	3.5	0.875	42.5	6	25.5	27	0.5625	4	100	635.5
W33x152**	< 1/4"	11.5	0.625	36.5	3.5	0.875	36.5	5	25.5	27	0.625	4	96	610.8
	other	----- Design by Hand -----												
W33x169**	< 1/4"	11.5	0.625	36.5	3.5	1	36.5	5	25.5	27	0.625	4	96	628.9
	other	----- Design by Hand -----												

**Denotes flange widths less than 12" where P/S Panel placement should be thoroughly investigated.

33" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices

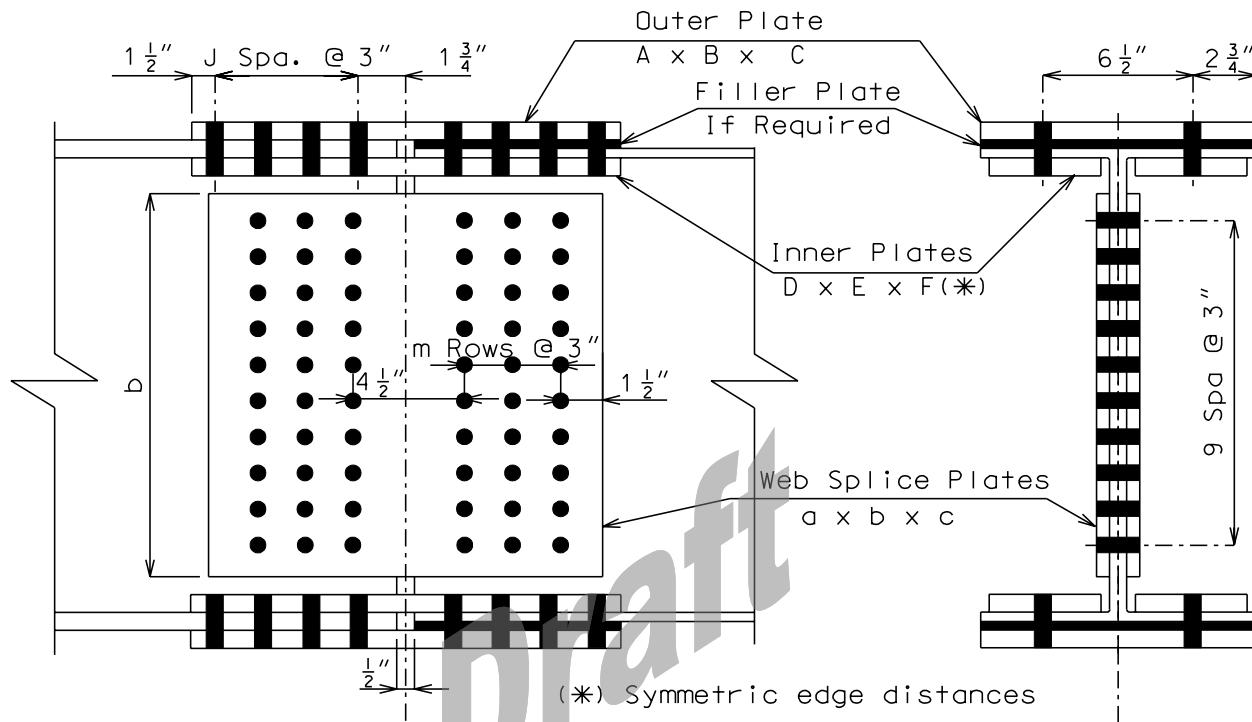


Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates					Web Splice Plates				Total # of Bolts	Weight (lb)	
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	a (in)	b (in)	c (in)	m			
W33x201	< 1/4" other	15.75	0.625	24.5	6	0.875	24.5	2	5.75	3	24.5	27	0.6875	4	88	624.2
W33x221	< 1/4" other	15.75	0.75	30.5	6	0.875	30.5	2	5.75	4	30.5	27	0.75	5	110	840.7

36" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices

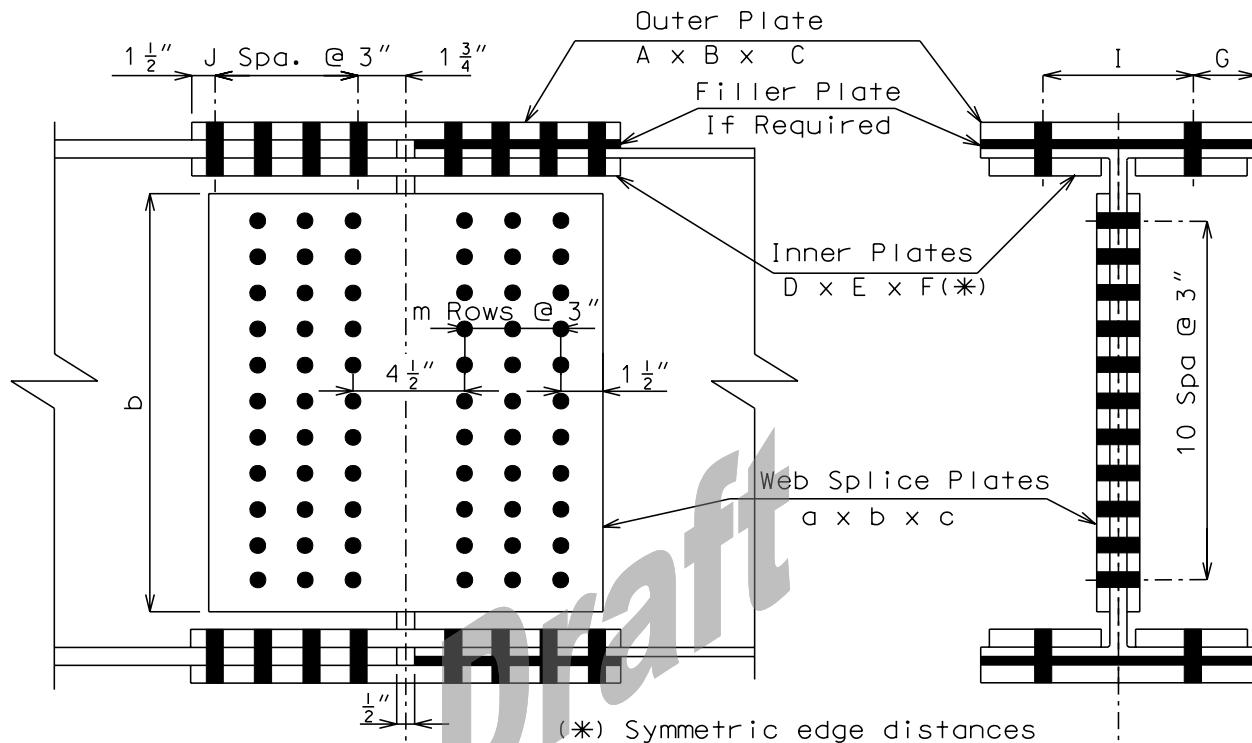


Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details.

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates			J	Web Splice Plates				Total # of Bolts	Weight (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)		a (in)	b (in)	c (in)	m		
W36x135	< 1/4"	12	0.625	30.5	4	0.625	30.5	4	19.5	30	0.5	3	80	458.1
	other	12	0.625	42.5	4	0.625	42.5	6	19.5	30	0.5	3	88	550.8
W36x150	< 1/4"	12	0.625	36.5	4	0.75	36.5	5	25.5	30	0.5625	4	104	622.3
	other	12	0.625	42.5	4	0.75	42.5	6	25.5	30	0.5625	4	108	672.0
W36x160	< 1/4"	12	0.625	36.5	4	0.875	36.5	5	25.5	30	0.5625	4	104	643.0
	other	Design by Hand												
W36x170	< 1/4"	12	0.625	36.5	4	0.875	36.5	5	25.5	30	0.5625	4	104	643.0
	other	Design by Hand												
W36x182	< 1/4"	12	0.75	42.5	4	1	42.5	6	25.5	30	0.625	4	108	783.5
	other	Design by Hand												
W36x194	< 1/4"	12	0.75	42.5	4	1	42.5	6	25.5	30	0.625	4	108	783.5
	other	Design by Hand												

40" Wide Flange Beams

ASTM A709, Grade 50 and 50W Webs, Grade 50 and 50W Splices



Note: Bottom flange splice plates are the same as the top. Provide shim plates when connecting webs that differ in thickness by 1/8" or more. Use an equal number of shim plates on each side of the web. Use the smallest beam size to determine splice details.

Size of Beam	Filler Plate Thick.	Outer Plate			Inner Plates					Web Splice Plates					Total # of Bolts	Weight (lb)
		A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	I (in)	J	a (in)	b (in)	c (in)	m		
W40x149**	< 1/4"	11.75	0.625	30.5	3.5	0.75	30.5	2.625	6.5	4	19.5	33	0.4375	3	86	459.2
	other	11.75	0.625	42.5	3.5	0.75	42.5	2.625	6.5	6	19.5	33	0.4375	3	94	552.5
W40x167**	< 1/4"	11.75	0.75	36.5	3.5	1	36.5	2.5	6.75	5	25.5	33	0.5	4	112	672.3
	other	11.75	0.75	48.5	3.5	1	48.5	2.5	6.75	7	25.5	33	0.5	4	120	787.6
W40x183**	< 1/4"	11.75	0.75	42.5	3.5	1.125	42.5	2.5	6.75	6	25.5	33	0.5	4	116	751.0
	other	11.75	0.75	42.5	3.5	1.125	42.5	2.5	6.75	6	25.5	33	0.5	4	116	751.0
W40x199(***)	< 1/4"	15.75	0.625	24.5	5.75	0.75	24.5	2	6.25	3	25.5	33	0.5	4	104	594.0
	other	-----Design by Hand-----														
W40x211**	< 1/4"	11.75	0.75	48.5	3.5	1.25	48.5	2.5	6.75	7	25.5	33	0.625	4	120	895.3
	other	-----Design by Hand-----														
W40x215(***)	< 1/4"	15.75	0.625	30.5	5.75	0.875	30.5	2	6.25	4	25.5	33	0.5625	4	108	715.4
	other	-----Design by Hand-----														

**Denotes flange widths less than 12" where P/S Panel placement should be thoroughly investigated.

(***) Outer splice plates with widths of 15 3/4" have 4 rows of flange bolts in lieu of 2 rows per drawing. See page 3.4-4 for similar details of flange bolt spacing.

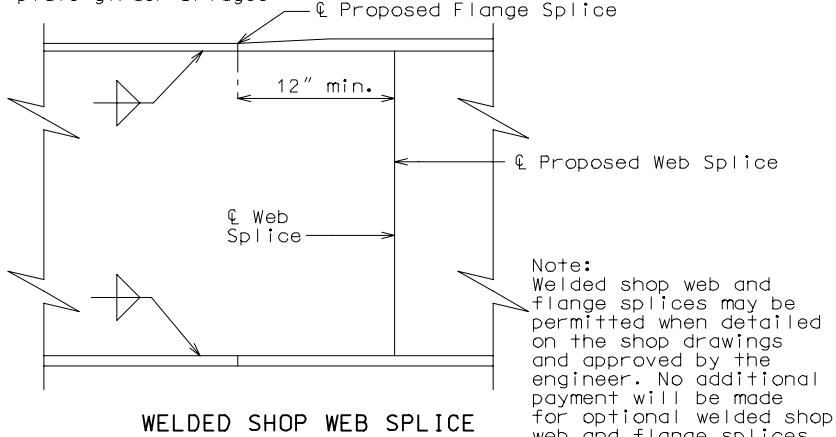
3.5 Shop Welded Splices
Plate Girder

Splice Details

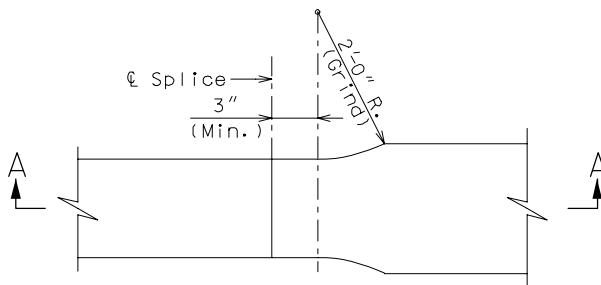
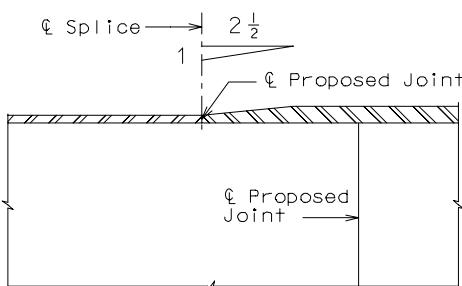
Reference:

LRFD Figure 6.13.6.2-1

The following details and note shall be provided on all plate girder bridges.

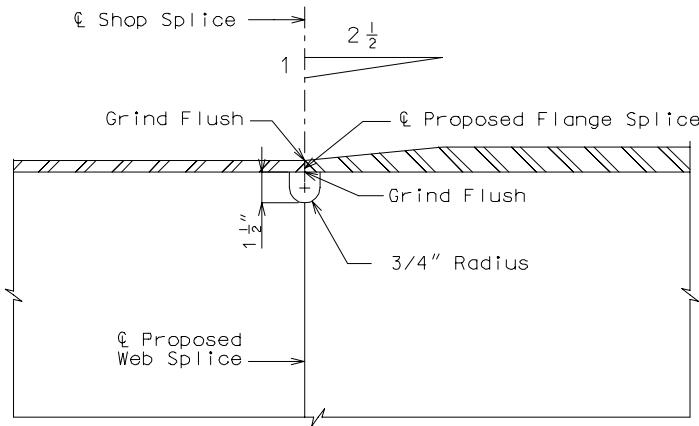


WELDED SHOP WEB SPLICE

PLAN
2'-0" RADIUS TRANSITION

SECTION A-A

WELDED SHOP FLANGE SPLICE



WELDED SHOP SPLICE

Notes:

See Structural Project Manager before utilizing this detail.
It is recommended to avoid this detail if possible.

3.43.4 Composite Design

4.1 General

Overview

LRFD 6.10.10

The pitch of shear connectors shall be determined to satisfy the fatigue limit state, and the resulting number of shear connectors shall not be less than the number required to satisfy the strength limit state.

The regions of the bridge subjected to positive flexure are to be designed as composite and the regions subjected to negative flexure are to be designed as non-composite. Simple span composite bridges shall be provided with shear connectors throughout the length of the span. Continuous composite bridges are to be designed with shear connectors provided in the positive flexure regions only, with additional connectors required in the regions of permanent load contraflexure.

Cross-section properties are based on the transformed short-term composite section. Cross-section properties of the composite section shall include concrete slab and steel section. Longitudinal deck reinforcement shall not be considered to be a part of the composite section. Cross-section properties of the non-composite section shall include the steel section only.

The stresses of composite girders and slab shall be computed using the composite cross-section properties and shall be consistent with the properties of the various materials used. The ratio of modulus of elasticity of steel to that of concrete, n , shall be taken to be 8 when using deck concrete with $f'_c = 4$ KSI.

The effective flange widths for calculating composite sections for interior and exterior girders should be determined by LRFD 4.6.2.6 prior to beginning shear connector design. In order to have a uniform and conservative shear connector design for all girders, the smaller effective flange width, between the interior and exterior girders, should only be used to locate the acceptable areas for placement of additional connectors near point of dead load contraflexure. The larger effective flange width should be used in all other calculations.

Design Loading

The girder shear force range due to fatigue loading, V_{SR} , should be determined from structural analysis prior to beginning shear connector design. The shear force range is the difference in the minimum and maximum shear force envelopes at any point. For design, use the average shear force range over the effective span (i.e. between contraflexure points).

The stress range in the longitudinal reinforcement due to fatigue loading, f_{sr} , should be determined prior to beginning shear stud design. In lieu of more accurate computation, f_{sr} may be assumed to be 10 ksi*.

- Note: This assumption is not provided by AASHTO LRFD, but is held over from AASHTO LFD Specifications.

Other Considerations

Shear connectors shall not be placed on the flange splice plates. Maintain at least 3" from end of splice plate to nearest connector for fabrication purposes.

The effect of the shear connector on the fatigue resistance of the flange shall be investigated using the provisions of LRFD 6.6.1.2.

Note: All spacing dimensions are measured to center of shear connector.

4.2 Shear Connector Limits

Shear Connector Proportions

Shear connector height, h_s , shall satisfy the following cover and deck penetration provisions:

LRFD 6.10.10

Minimum shear connector penetration into deck:

- For cast in place deck: 2 in.
- For prestressed panel option: minimum penetration to top of panel

Minimum concrete clear cover over shear connectors = 3 in.

Choose a shear connector height that is acceptable for both SIP and CIP deck options. Use 1 in. increments for selecting shear connector height. Minimum shear connector height = 4 in.

Shear connector diameter, d , shall satisfy:

$$\frac{h_s}{d} \geq 4$$

Recommended shear connector diameters, d :

- 3/4 in.
- 7/8 in.

Shear Connector Configuration

The following transverse spacing provisions must be satisfied when determining the number of shear connectors per row, n :

Minimum transverse shear connector spacing:

- Preferred minimum: 4d
- Absolute minimum: 2 1/4 in.

Minimum distance between edge of top flange and nearest shear connector:

- For cast in place deck: 1 1/2 in.
- For prestressed panel option: 4 1/2 in.

Shear connectors shall be placed by units. A shear connector unit refers to all shear connectors in a given cross-section, spaced transversely across the top flange. Multiple shear connectors per unit may be used if spacing and clearances allow.

4.3 Fatigue Design

Fatigue Resistance

The number of fatigue cycles for design, N , shall be determined as:

LRFD 6.6.1.2.5

$$N = (365)(75)(n_c)(ADTT_{SL})$$

Where:

n_c = number of stress range cycles per truck passage

$ADTT_{SL}$ = single lane average daily truck traffic.

LRFD 6.6.1.2.5

For longitudinal members not near interior supports*:

$n_c = 2.0$ for spans ≤ 40 ft.

$n_c = 1.0$ for spans > 40 ft.

* See LRFD Table 6.6.1.2.5-2 for other situations.

LRFD 3.6.1.4

In absence of better information, the single lane average daily truck traffic shall be taken as:

$$ADTT_{SL} = (p_{tr})(ADTT)$$

Where:

$ADTT$ = number of trucks per day in one direction, averaged over the design life

p_{tr} = fraction of truck traffic in a single lane

LRFD Table 3.6.1.4.2-1

Number of Lanes Available to Trucks	p_{tr}
1	1.00
2	0.85
3 or more	0.80

The shear fatigue resistance of an individual shear connector, Z_r , is determined as follows:

LRFD 6.10.10

$$Z_r = \alpha d^2 \geq \frac{5.5d^2}{2}$$

Where:

α = shear fatigue factor
 $= 34.5 - 4.28\log(N)$

Pitch

The maximum pitch of shear connectors along the longitudinal axis required to satisfy the fatigue limit state, p_{fat} , is determined as:

$$p_{fat} \leq \frac{n Z_r I}{V_{sr} Q}$$

Where:

n = number of shear connectors per unit

I = moment of inertia of the short-term composite section

V_{sr} = shear force range due to fatigue loading

Q= first moment of the transformed area of the slab about the neutral axis of the short-term composite section

Maximum pitch = 24 in.
Preferred minimum pitch = 6 in.
Absolute minimum pitch = 6d

Use 1 in. increments for pitch.

4.4 Strength Design

Resistance

The total nominal horizontal shear force between the point of maximum positive moment and each adjacent point of zero moment, V_h , is determined as:

$$LRFD\ 6.10.10 \quad V_h = \text{MIN} \left\{ \begin{array}{l} 0.85f'_c b t_s \\ F_{yw} D t_w + F_{yt} b_t t_t + F_{yc} b_f t_f \end{array} \right\}$$

Where:

- f'_c = 28 day compressive strength of deck concrete
- b = effective flange width
- t_s = effective slab thickness
- F_{yw} = yield strength of web
- D = web depth
- t_w = web thickness
- F_{yt} = yield strength of tension flange
- b_t = width of tension flange
- t_t = thickness of tension flange
- F_{yc} = yield strength of compression flange
- b_f = width of compression flange
- t_f = thickness of compression flange

The nominal shear resistance of a single shear connector embedded in a concrete slab, Q_n , is calculated as follows:

$$Q_n = 0.5A_{sc}\sqrt{f'_c E_c} \leq A_{sc}F_u$$

Where:

- A_{sc} = cross sectional area of a shear connector
- E_c = modulus of elasticity of deck concrete
- F_u = tensile strength of shear connector steel

The factored resistance of a single shear connector, Q_r , shall be determined as:

$$Q_r = \phi_{sc} Q_n$$

Where:

- ϕ_{sc} = resistance factor for shear connectors = 0.85

LRFD 6.5.4.2

Table 3.43.4.1 Calculated Resistance of Single Shear Connector

Q_r – Factored Resistance of One Shear Connector (deck $f'_c \geq 4$ ksi)	
Stud Diameter	Q_r (k)
3/4"	22.5
7/8"	30.7

The minimum number of shear connectors required for strength in each region, n_{str} , shall be computed:

$$n_{str} = \frac{V_h}{Q_r}$$

Regions are defined as the areas between points of zero moment and adjacent points of maximum positive moment. n_{str} is the minimum number of shear connectors that must be placed in each region to satisfy the strength limit state.

Additional Connectors

The number of additional connectors to be placed in the region of permanent load contraflexure, n_{AC} , shall be:

$$n_{AC} = \frac{A_r f_{sr}}{Z_r}$$

Where:

A_r = total area of deck reinforcement within the effective flange width
 f_{sr} = stress range in the longitudinal reinforcement due to fatigue loading

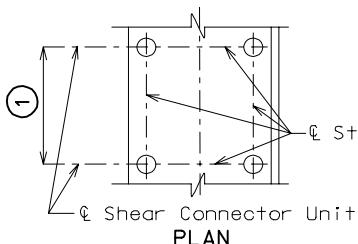
Minimum number of additional connectors = 4 units at 6d.

The additional shear connectors shall be placed within a distance of 1/3 of the minimum effective flange width on each side of the point of permanent load contraflexure.

If it is not possible to place additional connectors within $b/3$ from the point of dead load contraflexure, the additional connectors shall be placed as close to the contraflexure point as practical, using the minimum pitch of 6d.

4.5 Shear Connector Details

Composite Design



(1) 6" cts. preferred min., 6d cts. absolute min., 24" cts. maximum.
(1" increments min.)

(2) = 2" minimum for CIP slab;

(2) = a minimum height equal to the top of panel for P/S panel option.

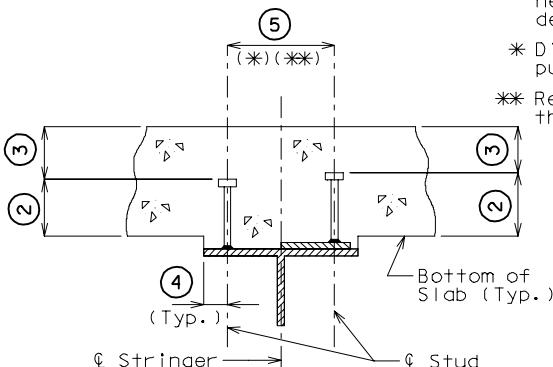
(3) 3" min. clear depth of concrete cover over shear connectors.

(4) 1-1/2" (Min.) CIP slab (*)
4-1/4" (Min.) panel option (*)

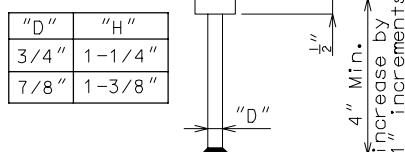
(5) 4 x (Stud diameter) preferred minimum, may be reduced if necessary for a more economical design; 2-1/4" absolute minimum.

* Dimensions are not for detailing purposes.

** Requires the same dimension throughout the span.



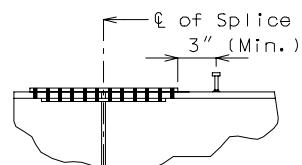
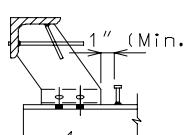
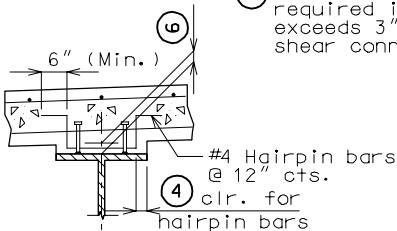
SECTION THRU COVER PLATE
(If required by design)



Min. Flange Width For Given Rows of Studs (in) (***)			WEIGHT IN PLACE PER 100 STUDS (lbs)				
# of Studs per unit, n	Absolute Min.	Preferred Min. 3/4" dia. / 7/8" dia.	Stud dia.	4"	5"	6"	7"
2	10.75	11.50	3/4"	61.0	74.0	86.5	99.0
3	13.00	14.50	7/8"	80.5	98.0	115.0	132.0
4	15.25	17.50					

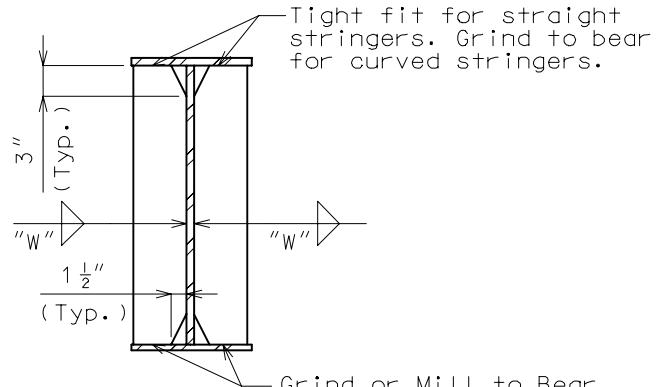
(***) For Decks utilizing prestressed panels.

(6) #4 Hairpin bars required if depth exceeds 3" for 5" shear connectors.

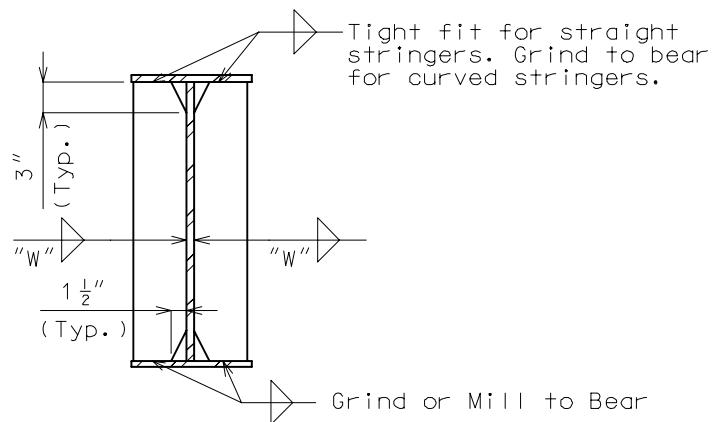


3.43.3 Details

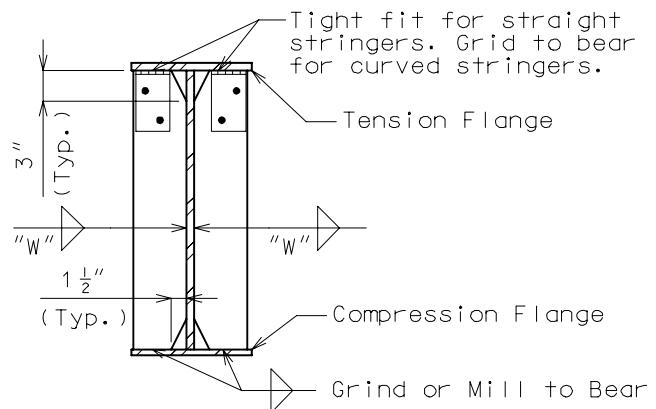
Details

3.1 Bearing Stiffeners
Connections

Bearing Stiffener Connections - No End Diaphragms or Cross Frames Attached

Bearing Stiffener Connections - End Diaphragms or Cross Frames Attached
(Preferred Detail. Design required.)

Design of weld or optional clip angle connection shall include fatigue investigation, diaphragm moment effects due to bridge skew and curvature effects.

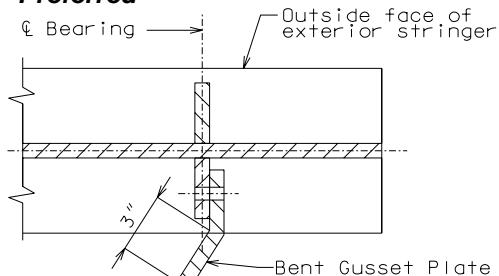
Bearing Stiffener Connections - End Diaphragms or Cross Frames Attached
(Optional Detail. Design required.)

"W" by design (1/4" min.)

Use 1/2" minimum thickness for bearing stiffener plate.

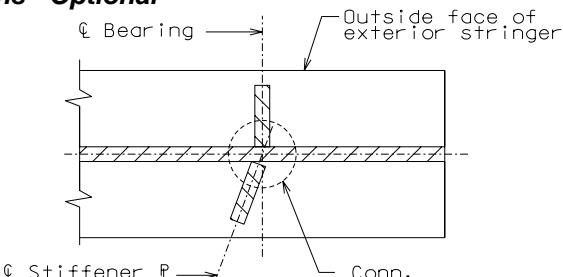
See page LRFD DG Sec. 3.43.5.1-4 for connection angle details.

Locations - Preferred

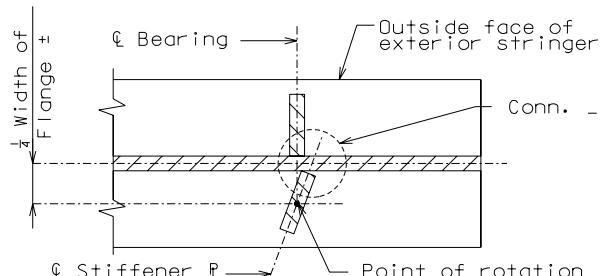


**End Diaphragms – All Skews
Cross Frames – Skews Thru 20°**

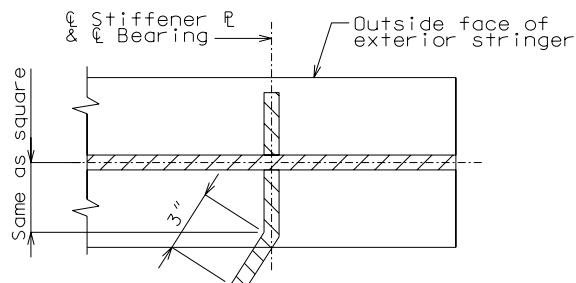
Locations - Optional



**End Diaphragms – Skews Thru 25°
Cross Frames – Skews Thru 20°**

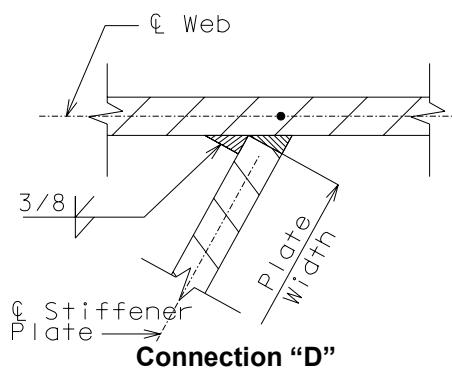
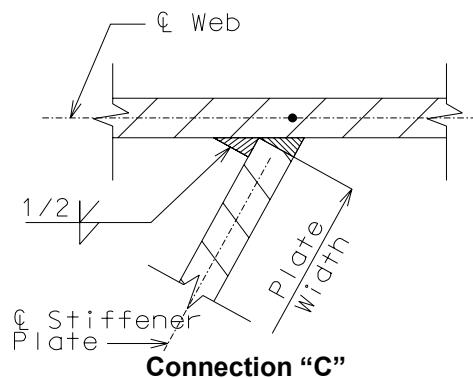
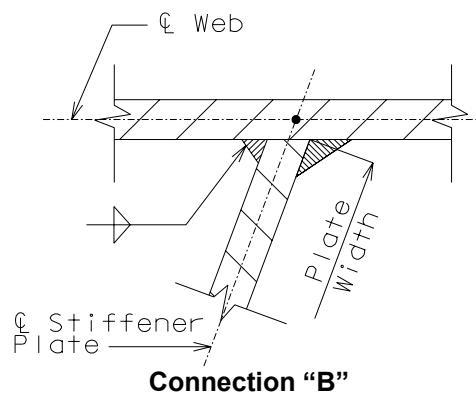
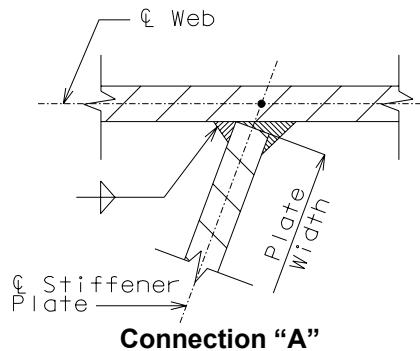


End Diaphragms – Skews Over 25° Thru 45°

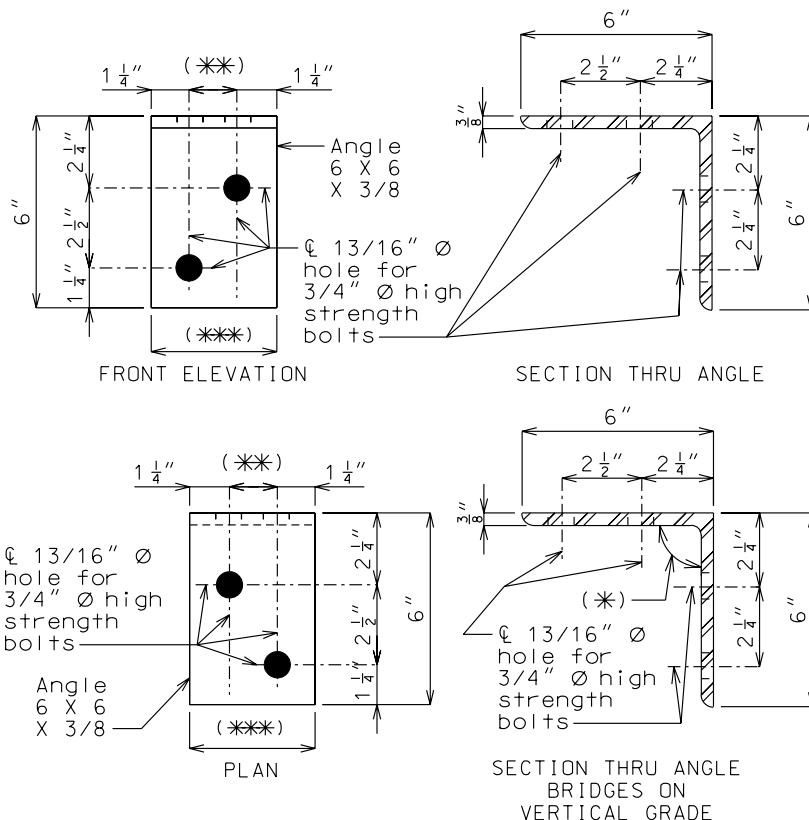


End Diaphragms – Skews Over 45°

Welds for Optional Stiffener Locations



Connection Angle Details for Optional Stiffener Connection



- (*) Angle legs shall be adjusted to conform to the variable angle between bearing stiffener and top flange created by the girder tilt requirement due to vertical grade.
- (**) ½" for W21 and W24 wide flange beam shapes. 1 ½" for all other wide flange beams and plate girders.
- (***) 3" for W21 and W24 wide flange beam shapes. 4" for all other wide flange beams and plate girders.

Table 3.43.5.1.1 Bearing Stiffener Connections For Given Skew And Stiffener Size

Skew	Stiffener Thickness (IN.)																		
	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	
0° THRU 5°	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	B	B	
6° THRU 10°	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	
11° THRU 15°	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
16° THRU 20°	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
21° THRU 25°	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
26° THRU 30°	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
31° THRU 35°	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
36° THRU 40°	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
41° THRU 45°	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	

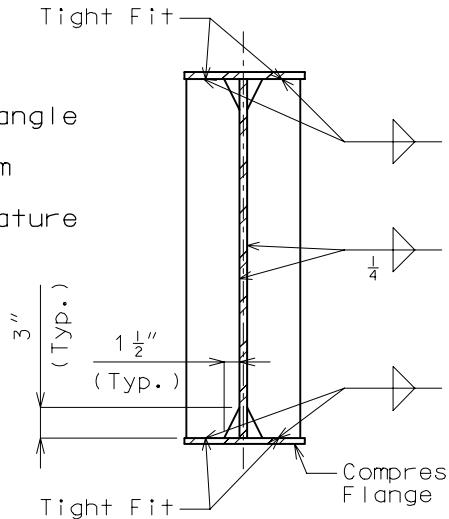
Details

3.2 Intermediate Diaphragms & Cross Frames

Connection Plate Details

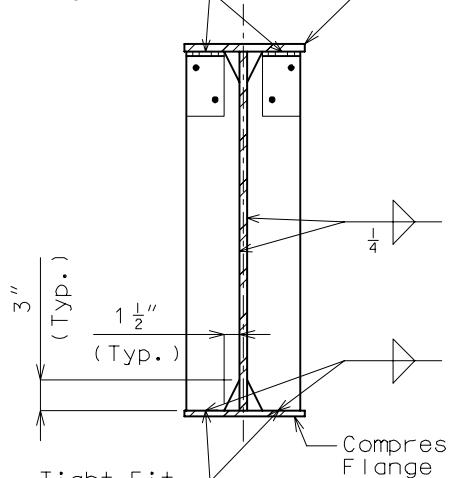
Tight Fit

Design of weld or clip angle shall include fatigue investigation, diaphragm moment effects due to bridge skew and curvature effects.



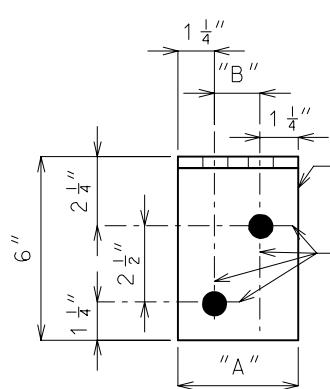
Intermediate Diaphragm Connection Plate
(Preferred Detail. Design required.)

Tight Fit

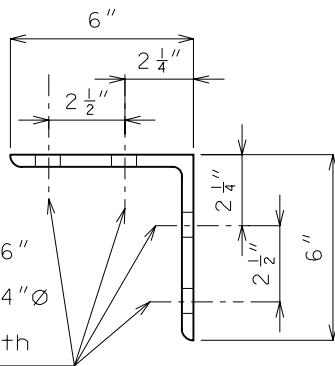


Intermediate Diaphragm Connection Plate
(Optional. Design required.)

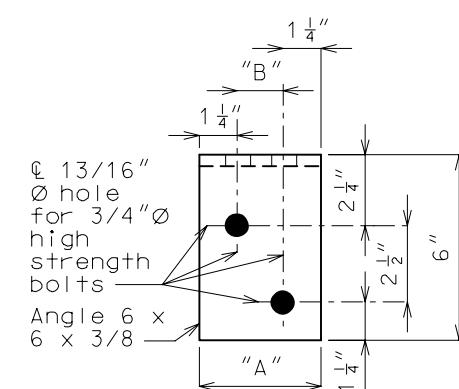
Connection Angle Details (See Table 3.43.5.2.1 for "A" and "B" values.)



Front Elevation
Detail of Flange
Connection Angle

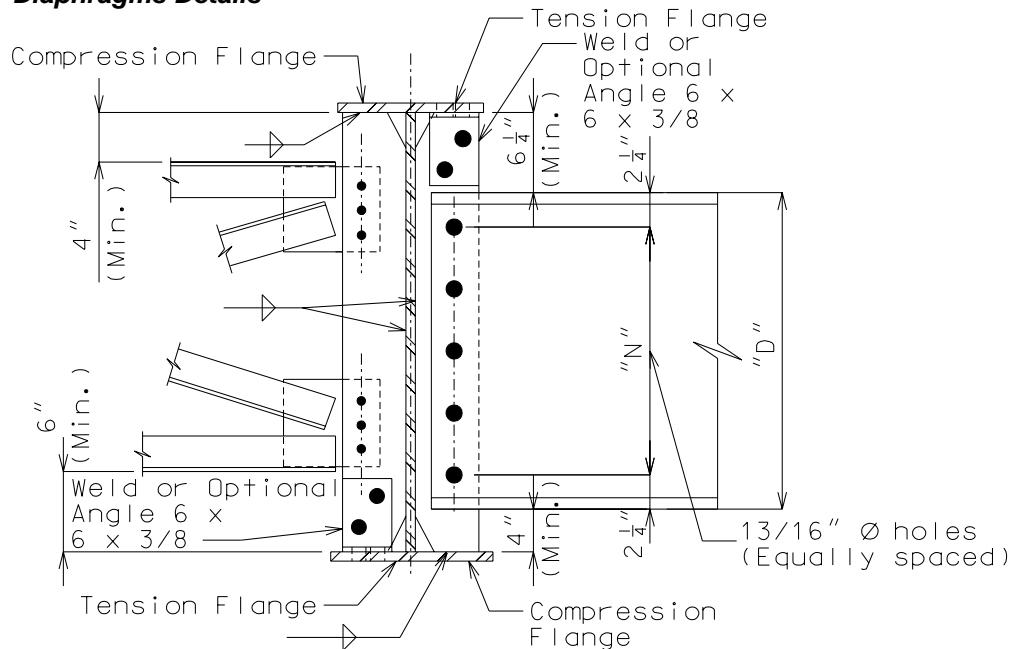


Section thru Flange
Connection Angle
6 x 6 x 3/8

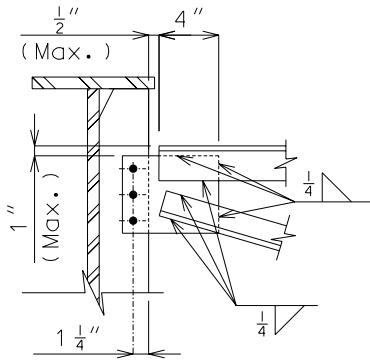


Plan Detail of Flange
Connection Angle

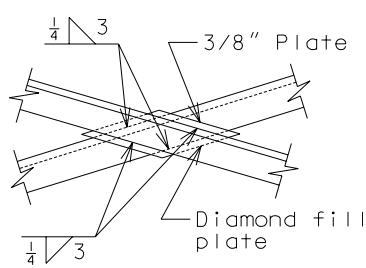
Diaphragms Details



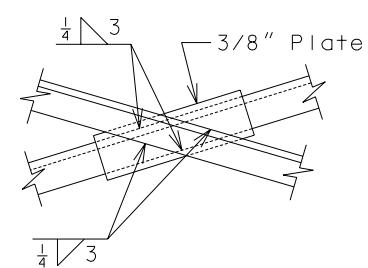
See Table 3.43.5.2.1 for "D" and "N" values.



Diaphragm Connection at Stiffener Detail



Fill Plate Detail - Preferred



Optional Fill Plate Detail for Contractor

Note: Top and bottom tension or compression flanges should be shown on the "Elevation of Girder" detail on plans.

Table 3.43.5.2.1 Intermediate Diaphragm and Cross Frame Details

Shape	"D" (IN)	"N"	Channel, Angle or Bent Plate (IN)	"A" (IN)	"B" (IN)
W21X48 THRU W21X93	12	4	C12X20.7	3	1/2
W24X68 THRU W24X103	12	4	C12X20.7	3	1/2
W27X84 THRU W27X129	15	4	5/16 X 23	4	1 1/2
W30X90 THRU W30X148	18	5	5/16 X 26	4	1 1/2
W33X118 THRU W33X221	21	5	5/16 X 29	4	1 1/2
W36X135 THRU W36X194	21	5	5/16 X 29	4	1 1/2
W40X149 THRU W40X215	21	5	5/16 X 29	4	1 1/2
36" thru 40" Plate Girders	21	5	5/16 X 29	4	1 1/2
42" Plate Girders	27	5	5/16 X 35	4	1 1/2
> 42" Plate Girders	Diagonal Member		L3X3X5/16	4	1 1/2
	Horizontal Member		L3.5X3.5X5/16		

ATTENTION DETAILER:

Intermediate diaphragm connection plates shall be detailed for Connection "A" for skews thru 20°. Details of Connection "A" are given in LRFD DG Sec. 3.43.5.1.

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 5.3-1

[Details](#)

5.3 End Diaphragms for Wide Flange Beams

Table 3.43.5.3.1 End Diaphragm Members for Given Wide Flange Beams

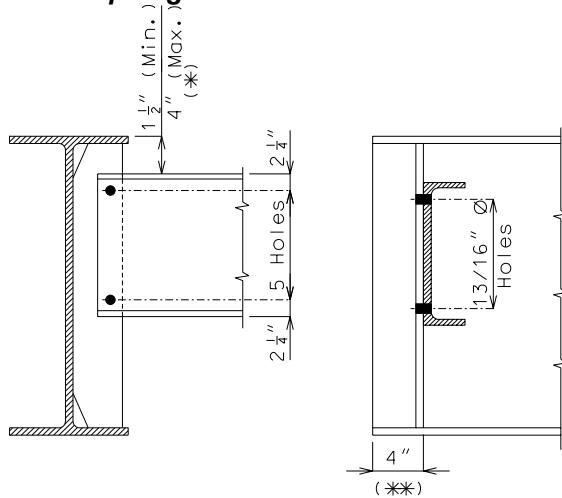
W21 thru W30		Stringer Spacing, FT							
Skew, deg.		7	7.5	8	8.5	9	9.5	10	10.5
0	C15X33.9	C15X33.9	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40	
10	C15X33.9	C15X40	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40	
20	C15X33.9	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40	W16X45	
30	C15X40	C15X50	C15X50	W16X36	W16X40	W16X45	W16X45		
40	C15X50	W16X36	W16X40	W16X45	W16X45	W16X50	W16X50	W16X57	
50	W16X40	W16X45	W16X50	W16X50	W16X57	W16X57	W16X67	W16X67	
60	W16X57	W16X67	W16X67	W16X67	W16X67	W16X77	W16X77	W16X89	

W33		Stringer Spacing, FT							
Skew, deg.		7	7.5	8	8.5	9	9.5	10	10.5
0	W16X31	W16X31	W16X31	W16X36	W16X36	W16X36	W16X40	W16X40	
10	W16X31	W16X31	W16X31	W16X36	W16X36	W16X36	W16X40	W16X40	
20	W16X31	W16X31	W16X36	W16X36	W16X36	W16X40	W16X40	W16X45	
30	W16X31	W16X36	W16X36	W16X36	W16X40	W16X40	W16X45	W16X45	
40	W16X36	W16X36	W16X40	W16X45	W16X45	W16X50	W16X50	W16X57	
50	W16X40	W16X45	W16X50	W16X50	W16X57	W16X57	W16X67	W16X67	
60	W16X57	W16X67	W16X67	W16X67	W16X67	W16X77	W16X77	W16X89	

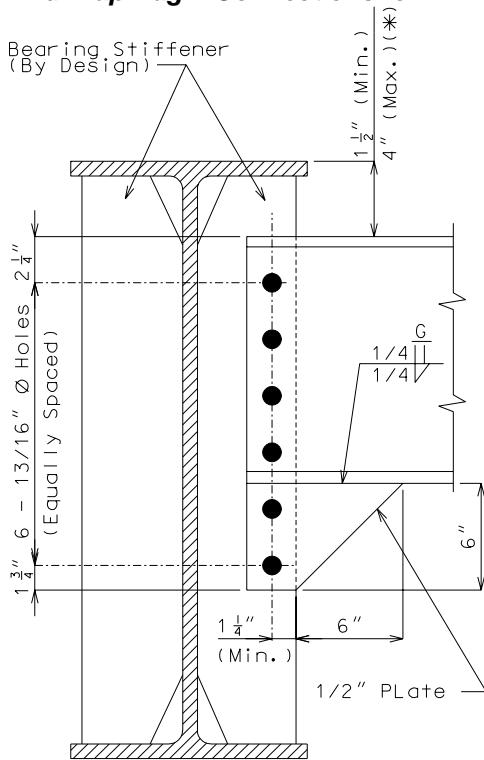
W36		Stringer Spacing, FT							
Skew, deg.		7	7.5	8	8.5	9	9.5	10	10.5
0	W18X35	W18X35	W18X35	W18X35	W18X35	W18X35	W18X40	W18X40	
10	W18X35	W18X35	W18X35	W18X35	W18X35	W18X35	W18X40	W18X40	
20	W18X35	W18X35	W18X35	W18X35	W18X35	W18X40	W18X40	W18X40	
30	W18X35	W18X35	W18X35	W18X35	W18X40	W18X40	W18X46	W18X46	
40	W18X35	W18X35	W18X40	W18X40	W18X46	W18X46	W18X50	W18X50	
50	W18X40	W18X46	W18X46	W18X50	W18X50	W18X55	W18X55	W18X60	
60	W18X50	W18X55	W18X60	W18X65	W18X65	W18X71	W18X76	W18X76	

W40 thru W44		Stringer Spacing, FT							
Skew, deg.		7	7.5	8	8.5	9	9.5	10	10.5
0	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
10	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
20	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
30	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
40	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X48
50	W21X44	W21X44	W21X44	W21X44	W21X48	W21X48	W21X48	W21X55	W21X55
60	W21X48	W21X50	W21X55	W21X55	W21X62	W21X62	W21X68	W21X73	

End Diaphragm Connections for W21 thru W24 Beams



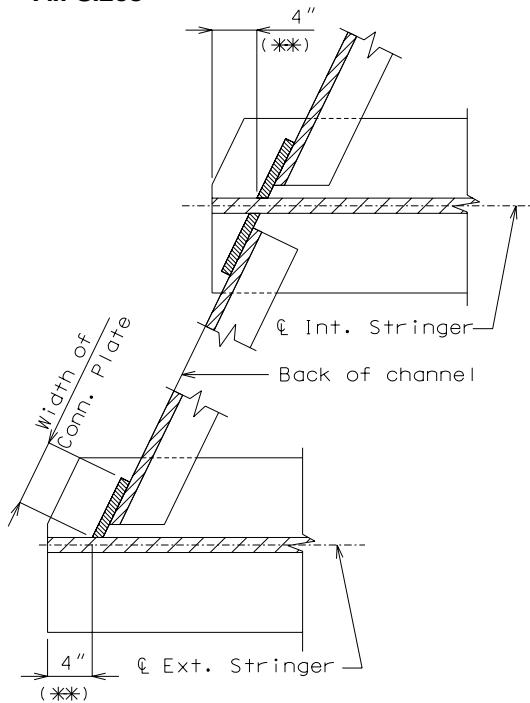
End Diaphragm Connections for W27 thru W40 Beams



(*) Slope diaphragms when structure is superelevated or when 4" maximum depth is exceeded. See LRFD DG 3.35 for the details of end diaphragms on a structure.

(**) Modify if necessary to clear the anchor bolts of the flat plate bearing or connection bolts of the expansion device.

All Sizes



ATTENTION DETAILER:

End diaphragms shall be detailed horizontally, stepped, or sloped as required.

LRFD Bridge Design Guidelines

Steel Superstructure – Section 3.43

Page: 5.4-1

[Details](#)

5.4 End Diaphragms for Plate Girders

Table 3.43.5.4.1 Top Horizontal Members for Given Web Depths

Webs Thru 40"	Girder Spacing, FT							
	7	7.5	8	8.5	9	9.5	10	10.5
0	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
10	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
20	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
30	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44
40	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X44	W21X48
50	W21X44	W21X44	W21X44	W21X44	W21X48	W21X48	W21X55	W21X55
60	W21X48	W21X50	W21X55	W21X55	W21X62	W21X62	W21X68	W21X73

Webs >= 42"	Girder Spacing, FT							
	7	7.5	8	8.5	9	9.5	10	10.5
0	C15X33.9	C15X33.9	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40
10	C15X33.9	C15X40	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40
20	C15X33.9	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40	W16X45
30	C15X40	C15X50	C15X50	W16X36	W16X40	W16X40	W16X45	W16X45
40	C15X50	W16X36	W16X40	W16X45	W16X45	W16X50	W16X50	W16X57
50	W16X40	W16X45	W16X50	W16X50	W16X57	W16X57	W16X67	W16X67
60	W16X57	W16X67	W16X67	W16X67	W16X77	W16X77	W16X77	W16X89

Table 3.43.5.4.2 Bottom Horizontal Members for Web Depths ≥ 42"

Web >= 42"	Girder Spacing, FT							
	7	7.5	8	8.5	9	9.5	10	10.5
0 thru 10	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16
20	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16
30	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L4x4x5/16
40	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L4x4x5/16	L4x4x5/16	L5x5x5/16
50	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L4x4x5/16	L4x4x5/16	L5x5x5/16	L5x5x5/16	L5x5x5/16	L5x5x5/16
60	L4x4x5/16	L5x5x5/16	L5x5x5/16	L5x5x5/16	L6x6x3/8	L6x6x3/8	L6x6x3/8	WT5x15

Table 3.43.5.4.3 Diagonal Members for Web Depths > 48"

Web <= 60"	Girder Spacing, FT							
	7	7.5	8	8.5	9	9.5	10	10.5
0 thru 50	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16
60	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16

Web < 112"	Girder Spacing, FT							
	7	7.5	8	8.5	9	9.5	10	10.5
0 thru 40	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16
60	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3x3x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16	L3 1/2x3 1/2x5/16

LRFD 6.8.4, 6.9.3

The members in Tables 2 and 3 were selected to meet only the

slenderness requirement $\frac{K\ell}{r} \leq 140$ for bracing members assuming

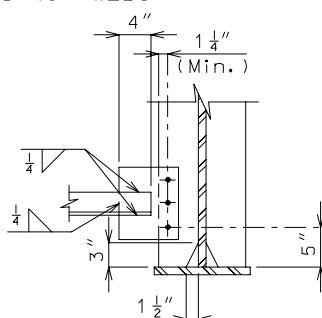
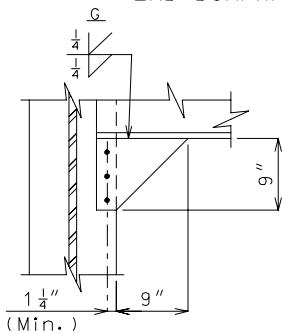
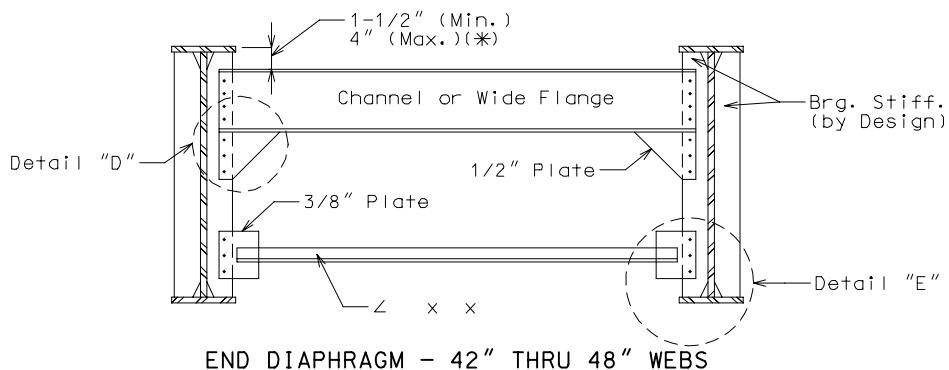
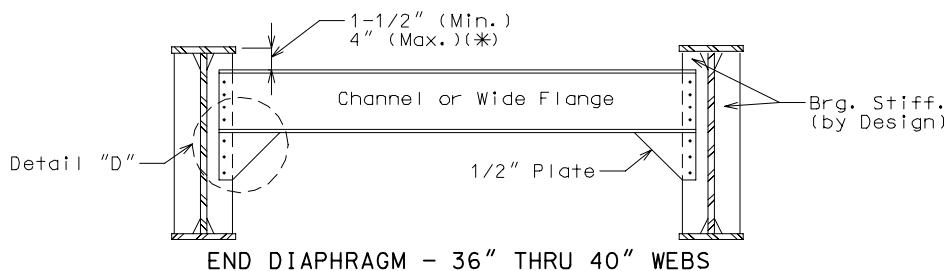
$$K = 0.75.$$

Diagonal members are assumed to be braced in the middle.

For girder spacing or skews not listed in table, use nearest tabulated angle size.

Enter the tables with the skew of the diaphragm, not the bridge skew. This is because some diaphragms are not placed on skew.

End Diaphragms



Note:

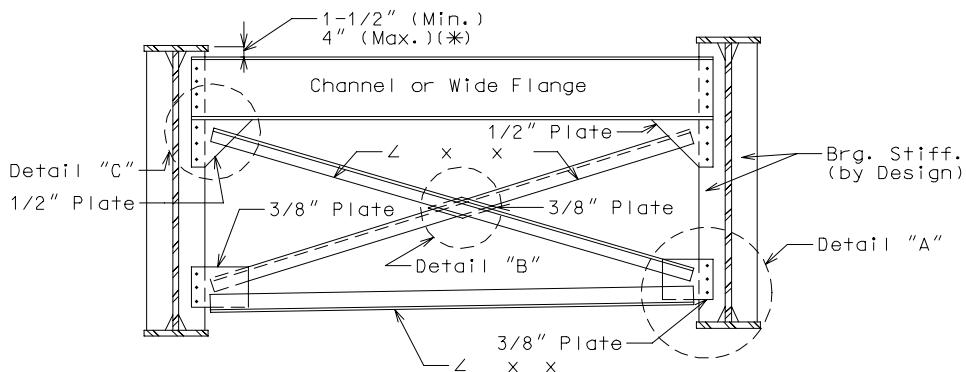
See tables in this section for size of diaphragm members.

See details for welding bearing stiffeners in LRFD DG Sec. 3.43.5.1.
Haunch slab to bear on channel or wide flange.

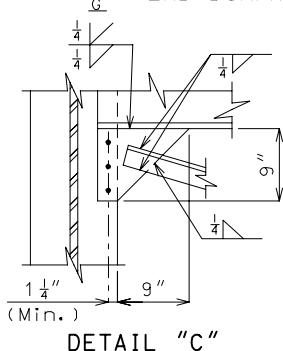
(*) Slope diaphragms when a structure is superelevated or when the 4" maximum depth is exceeded.

End Diaphragms (Cont.)

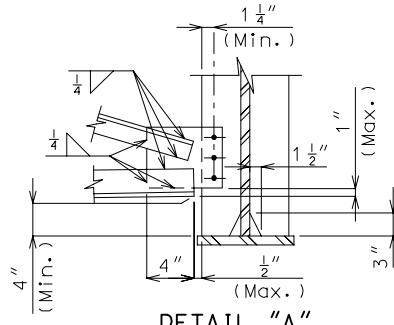
Details



END DIAPHRAGM - WEBS OVER 48"



DETAIL "C"



DETAIL "A"

Note:

See tables in this section for size of diaphragm members.

See details for welding bearing stiffeners in LRFD DG Sec. 3.43.5.1.

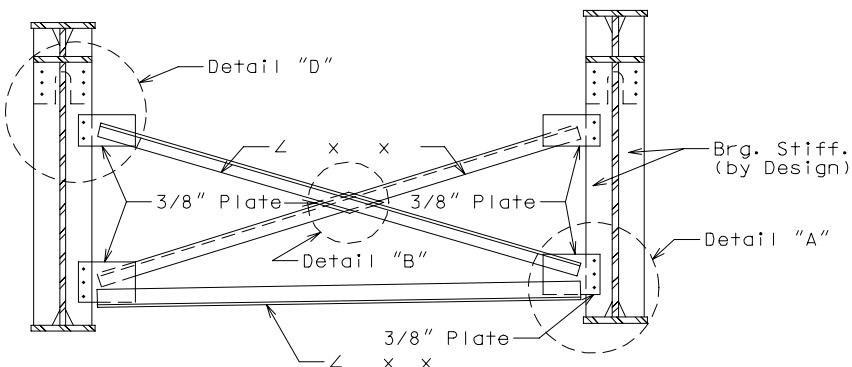
For Detail "B", see LRFD DG Sec. 3.43.5.2.

Haunch slab to bear on channel or wide flange.

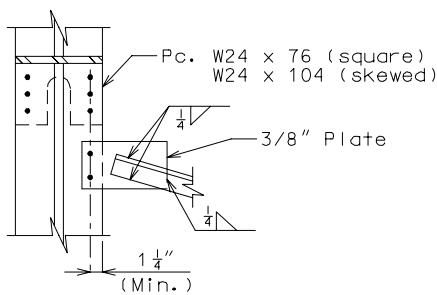
(*) Slope diaphragms when a structure is superelevated or when the 4" maximum depth is exceeded.

End Diaphragms (Cont.)

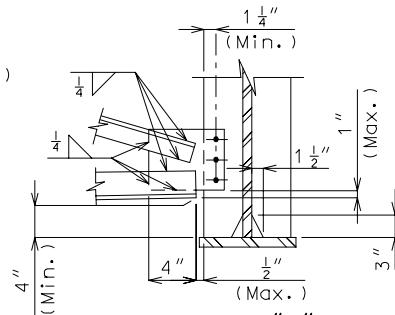
Details



END DIAPHRAGM - WEBS OVER 48"
STRUCTURE WITH FINGER PLATE EXPANSION DEVICE



DETAIL "D"



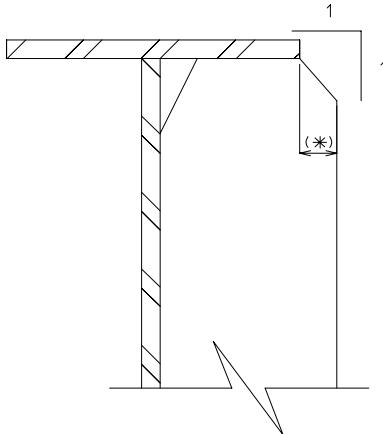
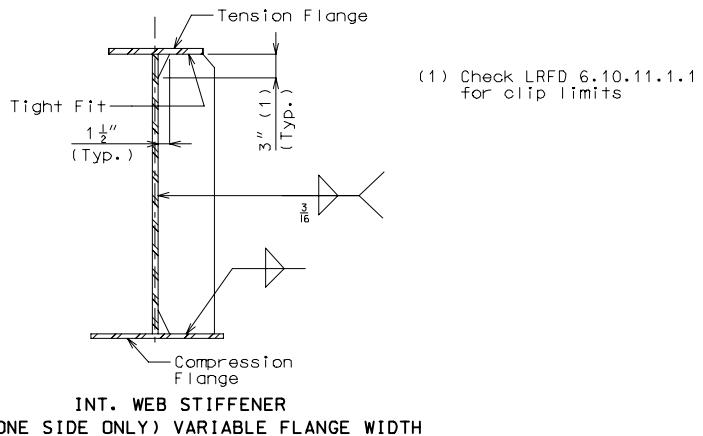
DETAIL "A"

Note:

See tables in this section for size of diaphragm members.

See details for welding bearing stiffeners in LRFD DG Sec. 3.43.5.1.

For Detail "B", see LRFD DG Sec. 3.43.5.2.

Stiffener Details**5.5 Transverse Web Stiffener Details**

DETAILS THRU BEVEL PLATE FOR INT. WEB STIFF.,
BRG. STIFF. AND INT. DIAPH. CONN. PLATES

(*) When dimension exceeds $1/2''$, bevel stiffener plate.

Note:
For intermediate web stiffener and intermediate diaphragm connection plate, use $1/2''$ minimum thickness.

Use $5-1/2''$ minimum width stiffener.

Width of plate shall be increased as required by $1/2''$ increments. Thickness of plate shall be increased as required by $1/8''$ increments when required thickness exceeds $1/2''$.

Transverse stiffeners shall be used on inside face of exterior girders and in successive alignment along either side of interior girders.

Top and bottom tension or compression flanges should be shown on the "Elevation of Girder" detail on plans.

5.6 Longitudinal Stiffener Details

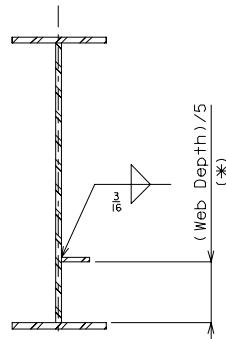
Stiffener Details

When longitudinal stiffeners are required they shall be used on the outside of exterior girders and in successive alignment along either side of interior girders.

The placement of longitudinal stiffeners may interfere with bolting the diaphragm or cross frame in place. Should this occur, it will be necessary to clip the longitudinal stiffeners as shown below.

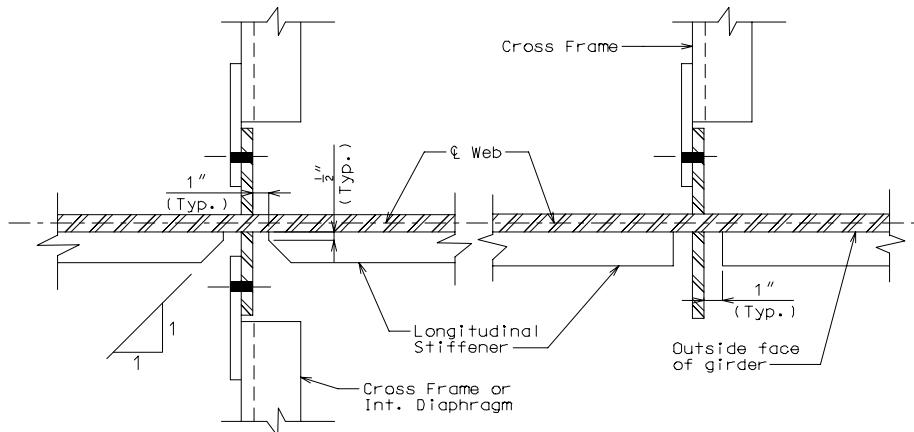
Also, when lateral bracing is required, place the longitudinal stiffener on the opposite side of girder.

The appropriate details shown below shall be modified as needed and placed on the design plans.



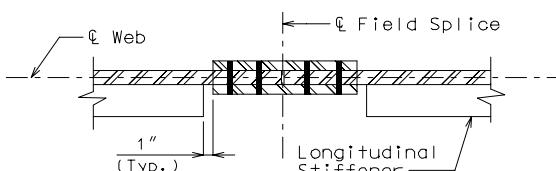
**LONGITUDINAL WEB STIFFENER
(ONE SIDE ONLY)**

(*) Location shall satisfy requirements of LRFD 6.10.8.3.



**INTERIOR GIRDERS
SQUARE OR SKEWED**

**EXTERIOR GIRDERS
AT INTERMEDIATE
BEARING STIFFENERS**



**TYPICAL SECTION AT
BOLTED FIELD SPLICE**

5.7 Lateral Bracing

Lateral bracing shall be omitted on all spans < 140 ft. Lateral bracing may be omitted on spans ≥ 140 ft provided the girder meets all applicable Strength limit states.

LRFD 6.7.5.2

Lateral bracing shall be placed in outer bays.

LRFD 6.8.4, 6.9.3

Members selected shall meet requirements of bracing members with $KL/r \leq 140$.

Under no circumstance shall lateral bracing be detailed to go through diaphragms. In order to facilitate erection, structural tees for lateral bracing may be inverted to connect to the top gusset plates.

Whenever practicable, diaphragms and lateral bracing shall connect to bearing stiffeners in bridges having large skews, diaphragms and lateral bracing need not connect to end bearing stiffeners for such structures but should connect to a girder midway between the bearing stiffener and the first transverse web stiffener.

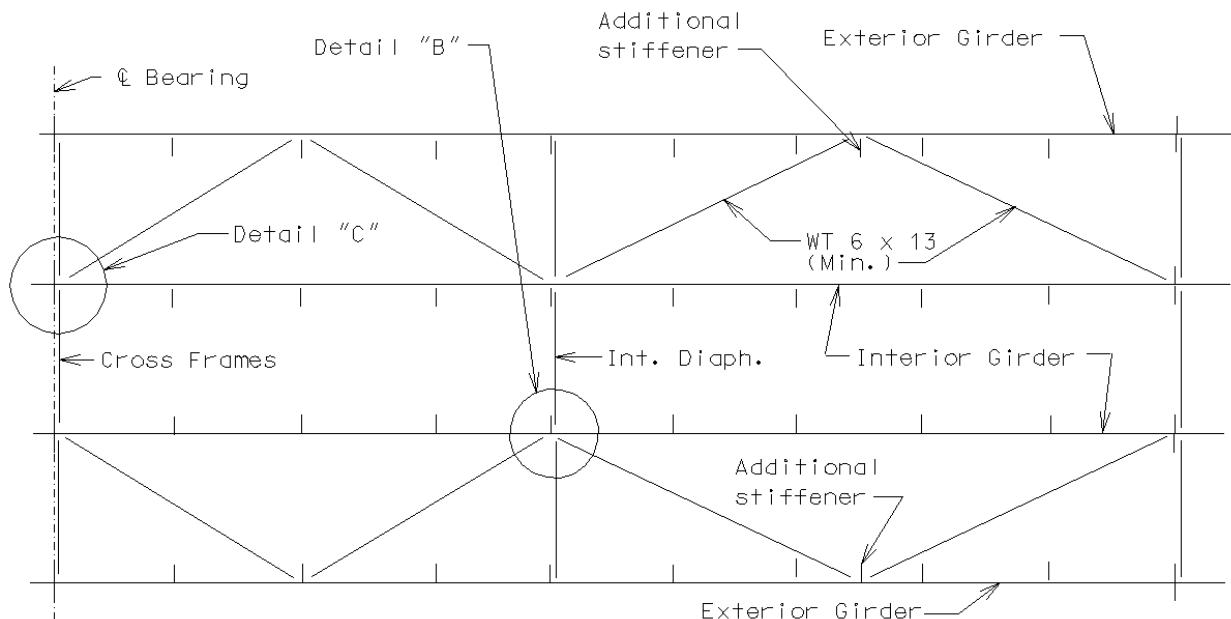
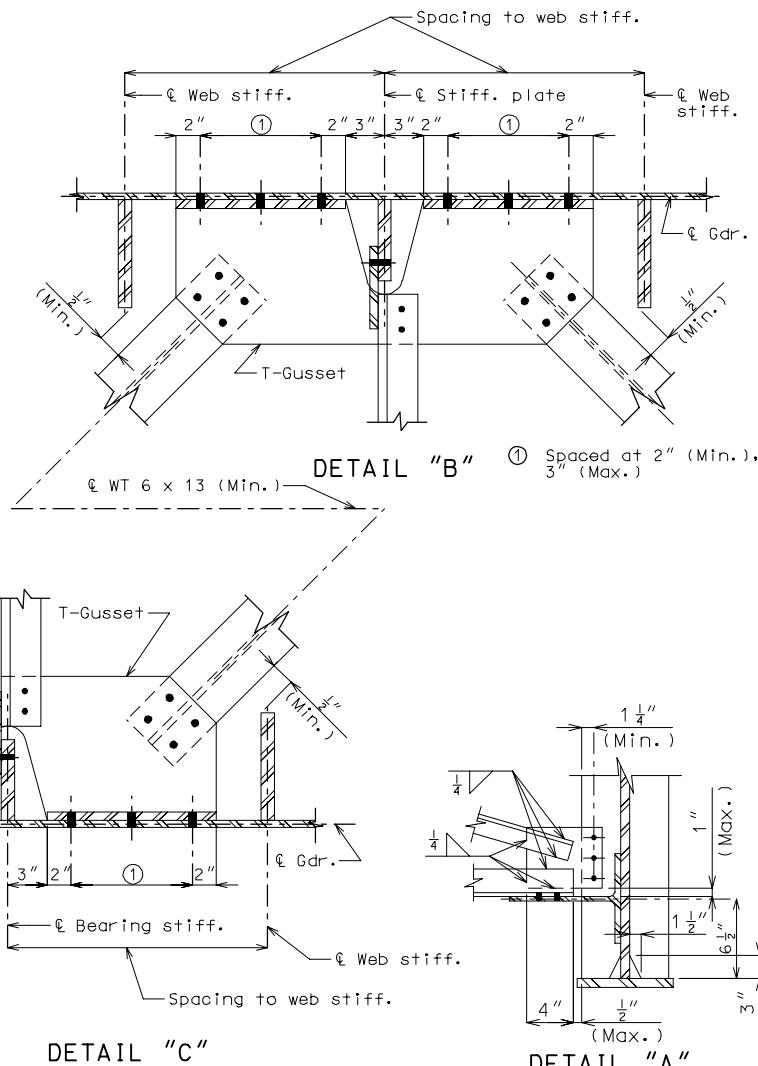


Figure 3.43.5.7.1 Part Lateral Bracing Framing Plan

See page 5.7-2 for Details "B" & "C".

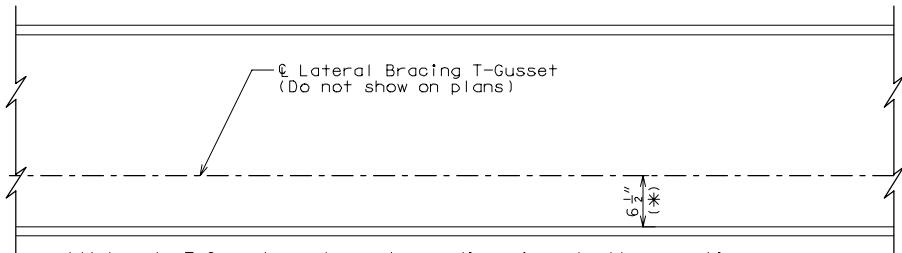
Lateral Bracing T-Gusset Details

Bracing Details



For location of Detail "A", see LRFD DG Sec. 3.43.5.4.
 (For bearing stiffener, see LRFD DG Sec. 3.43.5.1)

Note: Lateral Bracing T-Gusset shall be cut to required depth from W27 x 94, or T-Gusset can be built from plates in shop.

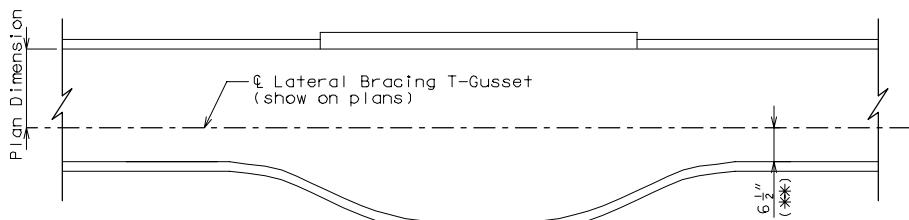


(*) Locate T-Gusset as shown above, dimension at all connections should be constant from top of bottom flange.

Place following note on plans:

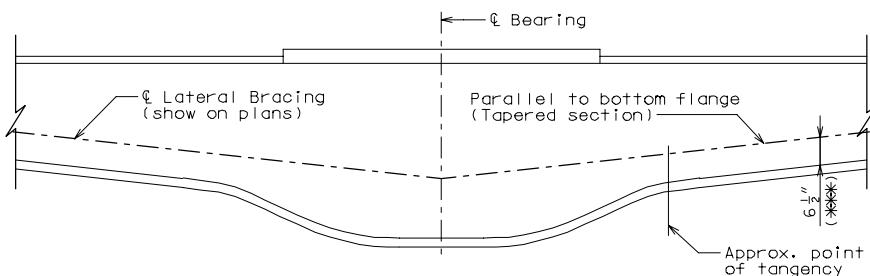
Note: T-Gusset shall be placed _____ (*) _____ inches above top of bottom flange.

CONSTANT DEPTH GIRDERS



(**) Locate T-Gusset as shown above, dimension at all connections should be constant from top of bottom flange in constant web depth portions.

CONSTANT - VARIABLE DEPTH GIRDERS



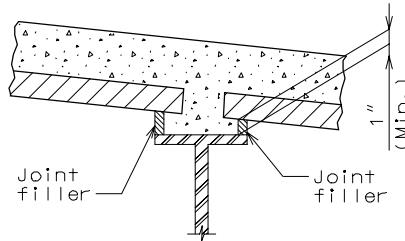
(***) Locate T-Gusset as shown above, dimension at all connections thru tapered section should be constant from top of bottom flange (Slope T-Gusset same as bottom flange). Continue same slope through variable depth section of girders.

TAPERED - VARIABLE DEPTH GIRDERS

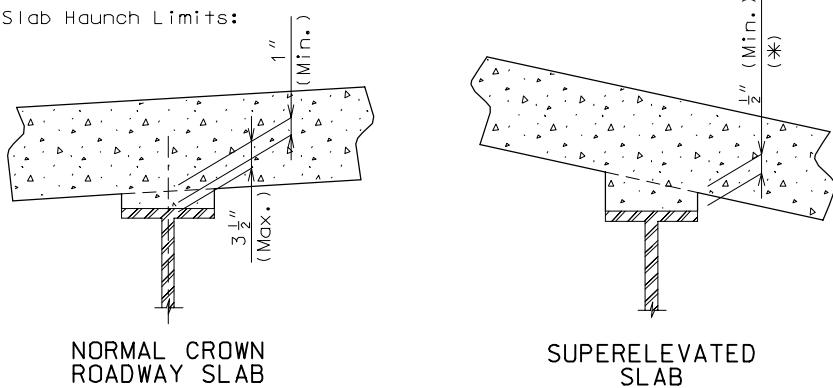
3.43.6 Miscellaneous Details**Miscellaneous Details****6.1 Girder Haunch****Prestressed Panel Section:**

Steel girders shall be cambered when using P/S Panels.

See LRFD DG Sec. 3.30.2 Prestressed Panels for joint filler/haunching details.

**Cast-in-Place Section:**

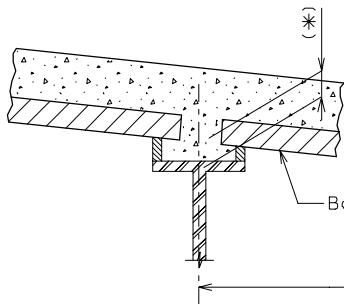
Girders shall not be cambered for CIP options unless maximum haunch limit is exceeded.

Slab Haunch Limits:

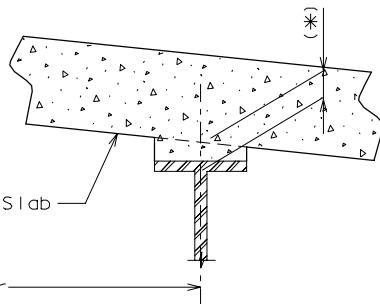
(*) 1/2" minimum edge clearance except over splice plates use 1/4" min. Maximum haunch limit of 3-1/2" may be maintained by changing girder slope at field splices or cambering girders.

6.2 Girder Camber and Dead Load Deflection**Straight Grade (Dead Load Deflection)**

Compute Dead Load Deflection at 1/4 points for bridges with spans less than 75', at 1/10 points for spans 75' and over.



**THEORETICAL
SLAB HAUNCH
(P/C P/S Panel Section)**



**THEORETICAL
SLAB HAUNCH
(C.I.P. Section)**

(*) Dimension (bottom of slab to top of web) may vary if girder camber after erection differs from plan camber by more than the % of Dead Load Deflection due to weight of structural steel. No payment will be made for additional forming or concrete required for variable haunching.

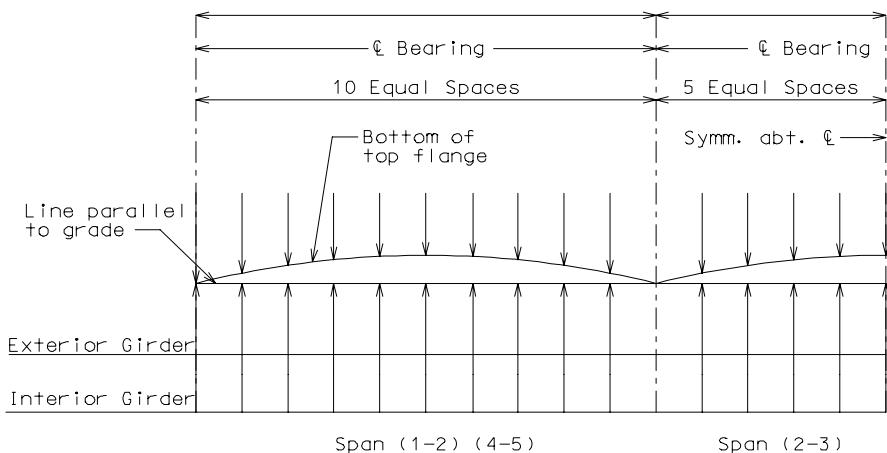
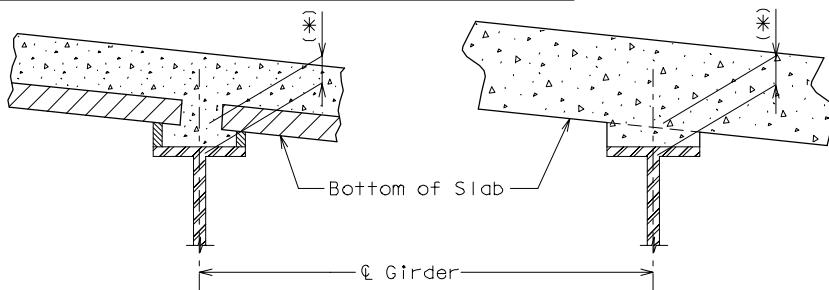


PLATE GIRDER CAMBER DIAGRAM

Note:

Camber includes allowance for _____ (*
_____) % of dead load deflection due to weight of structural steel.

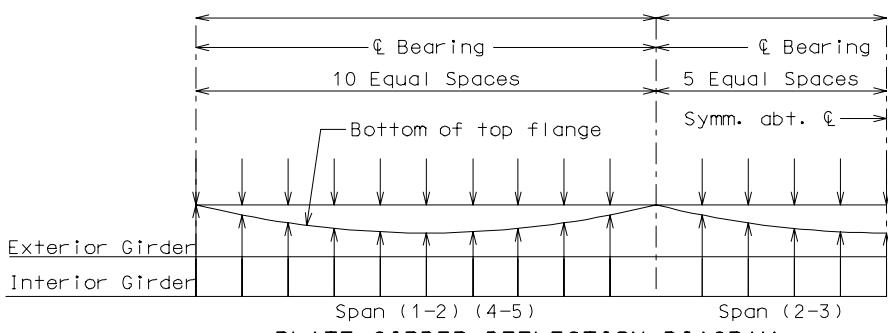
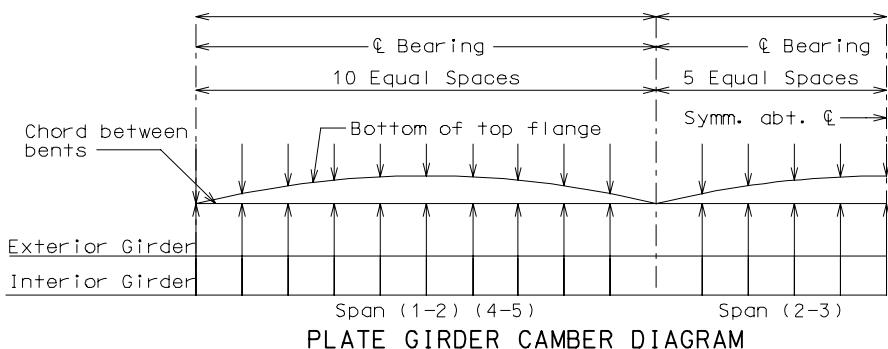
(*
_____) See LRFD DG Sec. 4 H for proper notes.

Vertical Curves (Dead Load Deflection)Miscellaneous Details

**THEORETICAL
SLAB HAUNCH**
(P/C P/S Panel Section)

**THEORETICAL
SLAB HAUNCH**
(C.I.P. Section)

(*) Dimension (bottom of slab to top of web) may vary if girder camber after erection differs from plan camber by more than the % of Dead Load Deflection due to weight of structural steel. No payment will be made for additional forming or concrete required for variable haunching.



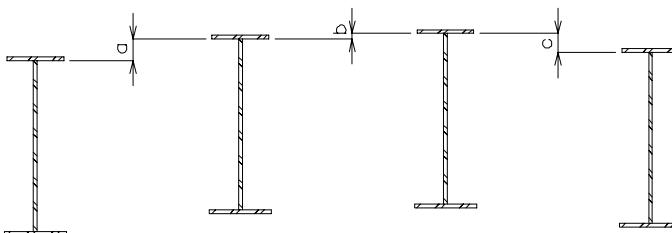
Note:

Camber includes allowance for _____ (***)
% of dead load deflection due to weight of structural steel.

(***) See LRFD DG Sec. 4 H for proper notes.

6.3 Girder Elevation Variation Sketch

Miscellaneous Details



SECTION THRU GIRDERS NORMAL TO Q ROADWAY

Typ.	Location	a	b	c
	Bt. No. 1 to Splice s1			
	Splice S1 to splice s2			
	Splice S2 to Bt. No. 4			

Dimensions showing girder variations shall be placed on the cross section thru slab or, if necessary because of the number and type of variations, the above type of detail and table shall be placed near the structural steel layout.

6.4 Spacing of Intermediate Diaphragms From Splice

